The Breeding of Live Stock

EPUB ISBN: 978-0-908327-54-6

PDF ISBN: 978-0-908330-50-8

The original publication details are as follows:

Title: The breeding of live stock : a new and fully tested theory

Author: Connell, J. A. (James Aitken)

Published: Thomas Avery & Sons, New Plymouth, N.Z., 1931

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Night Raid

THE BREEDING OF LIVE STOCK

A New and Fully Tested Theory

By

J. A. CONNELL

With foreword by

Dr. J. A. GILRUTH, D.V.S., F.R.S.E.,

lately Chief Veterinarian, Department of Agriculture, and Pathologist to the Department of Health, Dominion of New Zealand; also expounder of the fact that bovine tuberculosis is communicable to human beings; discoverer of the bubonic plague bacillus in New Zealand; and many other bacteriological successes of great value.

New Plymouth, N.Z.
THOMAS AVERY & SONS LIMITED
1931

Set up and printed by
THOMAS AVERY & SONS LIMITED
New Plymouth, N.Z.

Dedicated to

DR. J. A. GILRUTH, F.R.S.E., D.V.S.

IF a plebiscite were taken among the farmers of New Zealand as to whom a book relating to domestic animals should be dedicated, it is certain that the almost unanimous verdict would be in favour of the above-named gentleman. The reason for such unanimity is that every farmer in this country remembers with gratitude his brilliant professional work in keeping the country free from the disastrous ravages of the virulent diseases with which it was attacked. Anthrax, Swine Fever, Blackleg, and Hepatic Cirrhosis, the origin of which he was the first discoverer, all succumbed to his unique professional skill; and prompt treatment on his part saved the country from Bubonic Plague when, as Pathologist to the Department of Public Health, he discovered the first introduction of the deadly germs. When he successfully combated Dr. Koch's view that bovine tuberculosis was not communicable to human beings, and convinced the medical profession that it was communicable, he did a service to humanity that can never be adequately repaid. It is, therefore, but an insignificant tribute to him to offer the dedication of this little brochure, and a great honour to have it accepted in appreciative terms. The personal friendship existing undisturbed for so many years is thus enormously enhanced; but, sincere though it is, friendship has had no act or part in prompting this dedication as a well-earned tribute to outstanding skill and brilliant achievement.

THE AUTHOR.

REPORT TO THE MINISTER OF AGRICULTURE, NEW ZEALAND.

By Mr. J. Lyons, m.r.c.v.s.,
Director Live Stock Division, Department of Agriculture, N.Z.

The Minister of Agriculture having asked for a report on this new method of breeding, Mr. Lyons reported as follows:—

> "I have read the articles in question as they appeared in print, and while I am not entirely in agreement, I think there is much that could be brought before the notice of breeders to their advantage. The suggestion that the head is the dominant characteristic in breeding is a new one. Perhaps too much has been made of this feature in regard to breeding. At the same time I am of opinion that, all other points being equal, the animal with a good characteristic head is more likely to transmit its prepotency than an animal lacking in this direction. I feel sure it would be to the advantage of breeders generally if the articles were brought out in book form."

FOREWORD

"WHICH of you, by taking thought, can add one cubit to his stature?" This question, asked two thousand years ago, has but the same answer to-day. Notwithstanding the important observations and experiments by Mendel and his followers which heralded the science of genetics, the physical and mental characters of an animal reared under normal conditions of environment remain predetermined by ante-natal influences. True, these influences are varied and complex. As "vast arcs in the celestial sphere subtend but little angles here," so the vast arcs of ancestry subtend each individual's tiny angle.

Our knowledge regarding reproduction and breeding has, during recent years, advanced tremendously. Nevertheless, the practical application of genetics remains rather more an Art than a Science. Particularly is this so as regards the breeding of domesticated live stock. Every breeder is aware that pitfalls surround his path. He is guided by certain principles which are the outcome of his own and others' experience. Frequently, however, results attend his efforts, which are quite unexpected and often inexplicable. Like does not always "beget like," though in the main it does. While the disappointments usually can be laid at the door of heredity, thereby future mistakes and disappointments are not entirely avoided.

In the following pages Mr. J. A. Connell deals in a most interesting manner with the perplexities that confront the breeder and advances an enticing theory. He insists that in mating of animals, too much attention has been directed towards the physical conformation of the body, to the neglect of the characteristics of the mental and nervous system, as reflected in the head and the expression. His argument is maintained with much cogency and his illustrations are forcible. Every shrewd judge of human character knows how informative are the contour of the head and the facial expression. A man with a poorly developed under-jaw is not weak of character *because* of that, but it warns us without more ado that his character *is* weak. The converse holds good. Most people are more or less instinctively judges of character in others from facial expression. And the true character of an individual is as fixed by heredity as is the bodily conformation, though training and education may exert

modifying influences. Their effect, however, is usually more apparent than real. Too often it is but the veneer of civilization, easily cracked under highly abnormal conditions.

To the average European, two Chinamen are much alike. Even more closely do two bulls of the same breed resemble each other to him. Granted, therefore, that all Mr. Connell's conclusions are correct, difficulty remains in the effective promulgation of his theory. Definite measurements may be made of the body, its lines and angles, all of which may be co-ordinated, as indeed they always are in the eye of the expert breeder of live stock. But to reduce "expression" to exact terms is a severe tax on descriptive powers. Hence, breeding, if further experience confirms Mr. Connell's theory, will remain to a great extent still an Art.

This note is merely an appreciation. My personal experience is too limited to enable me to advance criticism. That can be safely left to others. But all, I venture to think, will find a perusal of Mr. Connell's work interesting and stimulating. Many will find it valuable.

J. A. GILRUTH.

Melbourne,

1st February, 1931.

CONTENTS

LIST OF ILLUSTRATIONS

PREFACE.

THE following pages (necessarily condensed because the author's contract limited him to ten columns) were recently published in two New Zealand metropolitan journals—the *Otago Witness*, Dunedin, and *The Dominion*, Wellington. It was not then intended by the author to do more than sketch the outlines of a theory in breeding of animals resulting from his numerous experiments and a close study of the subject extending over thirty years. At first it was regarded by him merely as a hobby; but the results obtained in the crossing of animals of different types—horses, cattle, sheep, dogs, fowls, etc., were so inexplicable as to be almost amazing. Needless to say, the experimenter first set out with the all-too-common but erroneous notion that defects in conformation could be corrected in the immediate progeny by merely mating the defective animal with one of an opposite type. Pedigrees, too, occupied an unduly exalted position in his estimation until repeated failures showed that, beyond all doubt, they were *per se* unreliable guides, yet not wholly indispensable because of the guarantee they afforded that no percentage of hybridization had entered into the strain to be experimented with. Body characteristics, also, were carefully noted and used in the experiments; but the results were always disappointing. What did those failures portend, and where were their causes to be sought? That was the puzzle, and it remained a puzzle until one day the author met a man riding a gelding and leading a thoroughbred stud horse and noticed the contrast of the two heads. Surely there must be a cause for that contrast; but what was it? Clearly it was the natural effect of emasculation; but why were other parts of the body not affected by the operation? Here was another problem to be solved, and one not so simple as it appeared at first sight. Was it to be inferred, for instance, that the existence of certain glands had a distinct influence upon the shaping and development of the brain and head? It appeared so on cursory examination; but it involved a palpable absurdity, for it implied the removal of control in development from the brain to the glands themselves.[1] Experiments with Wyandotte fowls, so notably addicted to the hatching

[1] It is now known that certain glands assist in the process of development, but they do not control it. The head and crest bear evidence of the influence of certain generative glands so long as they remain in the body. Indeed, it may be reasonably assumed that all the glands in the body act as chemical reservoirs, so to speak, imparting their contents

instinct, followed this investigation in order to show whether or not that dominant family instinct could be modified or controlled, and if so what would be its effect upon any or all the other functions of the body. The results were as curious as they were unique, for while the experimenter succeeded in producing a bird with shape and feathers fit to satisfy the most fastidious fancier, one that layed 317 eggs in one year and never clucked during her eight years of life, not one of those eggs was fertile; but it was quite noticeable that her head showed more of the masculine than the feminine expression, and the rose comb showed a marked tendency to depart from the orthodox shape. Here was an inspiring result clearly showing that the head alone was affected because the brain was relieved of the sex incubus, and the somatic or body cells profited by the change and exercised their several functions more freely.

Quite a series of other experiments were also tried by mating effeminate-looking males with masculine-looking females and *vice versa*, and in no instance were the progeny up to the standard of what they ought to have been in view of the character and pedigrees of the parents experimented with. Here again was important verification of the idea that the brain was the potent factor in the transmission of hereditary characteristics. Pursuing this line of investigation, the author proved (to his own satisfaction at least) that it was possible to select a sire or dam that, when properly mated, would produce some improvement in the progeny; but he kept his conclusions to himself until he had tested the matter beyond all doubt, until one day, when on a visit to a sheep-farmer friend at Mauriceville, he was asked what he thought of a number of flock rams then in the yards, and he unhesitatingly replied, "You have not a good one among them." The owner, evidently not appreciating the answer, said no more until an hour later, on the way to the homestead, he pointed to his stud rams and again asked, "What do you think of those?" There was no need for hesitation and the answer was promptly given—"You have one, only one, decent one. He is a good sheep; but, for stud purposes I would not have him."

Then the owner, smiling satirically, said, "Why, that's one of ———'s rams (naming a then very noted stud Romney

by a process called metabolism, as required in the body-building process. Professor Sir Ernest Rutherford has made it quite clear that every element is made up of atoms, and that the atoms of one element may be completely altered in their nature and action to another element totally unlike it by shooting off one or more of its electrons, so that lead may in this way be converted into gold if the process is carried far enough; but it would be extremely expensive to produce gold in this way.

breeder) and I paid a big price for him. What's wrong with him?"

That smile had its effect in the answer given, which was this: "You know I have never seen that ram before, and that I know nothing of his pedigree, and I don't care if it is the Archangel Gabriel who bred him; but first let me ask you how long you have used him," and on receiving the reply "Two years," he proceeded, "Then you will know whether I am correct or not in what I am going to tell you. That ram is on the down grade: that is, he is not as good as his sire, and none of his progeny is as good as he is. Now tell me whether I am right or wrong."

He hesitated, then said, "Well, that fellow has puzzled me. I thought I had a gem; but I must confess I am disappointed with him; but how did you know that he was not a success? You have not seen him before, and you have not examined him yet."

"My friend," was the reply, "you, no doubt, examined what are known as his 'body characteristics,' his wool, etc.; every breeder does; but you have omitted the important part—his head. That head told me the tale at first glance."

Encouraged by the foregoing incident, which took place some sixteen or eighteen years ago, and others of a similar nature, the author at last decided to place the whole details before breeders in serial form through the Press, and requests from breeders in various parts of the Dominion of New Zealand for copies of those articles in book form has resulted in the issue of this little volume. Already the suggestions contained therein are adopted by some of the principal sheep breeders, who have read the newspaper articles that have been revised and enlarged in this book.

It would be folly to think that all and every breeder will accept the arguments and facts herein used, because existing notions and prejudices have first to be dealt with; but the author can fairly claim to have thoroughly tested the hypothesis on all sides before arriving at his conclusions founded upon physiological facts, unbiased observations, and numerous carefully-controlled experiments. The long time occupied in these investigations and their variety prove that no hasty conclusions have been arrived at. Mark Twain has said, "The man with a new idea is a crank until the idea succeeds;" but the author has no fear of being called a "crank," because the idea has already succeeded beyond all expectations, and the fact that its basic principles are so forcibly and clearly supported by such high authority as Major-

General Sir Frederick Smith, A.R.V.S., Director-General of Army Veterinary Science in his book on "Veterinary Physiology," that there is no further cause for doubt upon the subject.

The author desires to acknowledge gratefully the kindness of Dr. J. A. Gilruth, D.V.S., F.R.S.E., for the letter appearing as a foreword on another page, and also to express his sincere thanks to Mr. J. Lyons, M.R.C.V.S., for his favourable comments on the author's work in his report to the Minister of Agriculture. Dr. Gilruth's scientific work in New Zealand as Chief Veterinarian, and Pathologist to the Department of Health, his discoveries in the origin of diseases in this country (both animal and human), have been acknowledged by the Medical and Veterinary professions as standard work of the highest order, and are quoted everywhere with approval, and his professional reputation is world-wide.

Mr. Lyons is the very competent Director of Live Stock Division, Department of Agriculture, New Zealand, who cannot be induced to express a decided opinion upon any question outside that of animal diseases.

Supported to such an extent as they have been by such high authorities, this new theory of animal breeding is with added confidence submitted to breeders throughout the British Dominions and other countries by

THE AUTHOR.

CHAPTER I

MENDELISM.

THIS is no new subject, and so much has been said and written upon it that to say or write more until some new discovery has been made would seem to be quite superfluous. Scientific investigators have endeavoured to probe its mysteries since the days of Mendel, and his experiments in the hybridisation of peas has led to the adoption of a hypothesis which the most modern writers on animal-breeding have not yet ignored.

Few people outside the ranks of the scientific investigators can discern any connection between a pea and an animal from the breeder's viewpoint, yet Mendel's experiments with peas, when repeated in the crossing of animals such as guinea pigs, etc. (black and white), produced very similar results, and supported his theory that in successive crossings there were certain well-defined proportions of what he called "dominants" and "recessives." The "dominants" were those hybrid animals or plants that most nearly resembled the original parents, and they were generally produced in the proportion of 1 to 3 in the first cross, while the "recessives" were those of the progeny that showed greater variation in size, shape, and colour. Volumes have been written upon this line of investigation; but, interesting and informative though the subject is if our sole object is to produce a new species, the stock breeder has a different object in view—the improvement of his flock or herd—and is therefore not much assisted by the facts revealed in regard to hybrids.

The invention of the microscope has turned investigation in another direction, and the examination of the behaviour and development of the chromosomes and centrosomes has up to the present day occupied the attention almost entirely of those who are studiously, and intelligently too, pursuing the mysteries of breeding. They have watched the single cell through all its phases of development and aggregation grow into the multicellular fœtus and the mature animal, and yet the mystery is not solved. They can with absolute certainty describe the process of change that takes place from the germ plasm to the birth of an animal, but the elusive principle that directs that growth will continue to elude them until the origin of life itself has been discovered, and that time is not yet. Hence it may be stated that those researches also are at present of little avail to the anxious breeder, whose object is to produce this year better animals than those he possessed last year.

Yet another line of research has engaged the attention of quite an army of clever men, who have ransacked the museums, dived into the bowels of the earth for specimens of animal structure, made comparisons, and arranged them in chronological order showing beyond dispute that our present stock have descended from primitive animals of vastly different structure. They have shown, too, that this process of change has been very slow and continuous over immense periods of time, controlled only by Nature, and therefore those examples (now well classified and preserved) afford most valuable lessons to the students of animal propagation. These will be again referred to.

It is not here intended to throw any doubt or discredit upon the work of those biologists of the Mendelian school, such as Weismann, Lubbock, de Vreis,

and others, for the worst that can be said of it is that, while it contains important discoveries in regard to heredity, it is not so helpful to the modern breeder as that of Darwin, Nilsson, Rutmeyer, Cuvier, Lamarck, and a host of other paleontologists who have shown us the path of evolution along the centuries, and pointed the way to further development. Yet we find one of the latest of the Mendelian school (Darbishire, 1911) committing himself to the following statement:—

"Mendel's work points to the established principle that the contents of the germ cells, and not the outward characteristics of the animals dealt with must be our guide in breeding."

If that is so (and it may be strictly correct) there is but a gloomy prospect for the farmer who is endeavouring to improve his flock or herd, for how is he to study the germ cells of his live animals before deciding year by year how he is to mate them? Is he simply to sit down and wait for further discoveries of the microscopists? No farmer will be inclined to accept that view whether or not it may be scientifically true; but he need not worry, because other authorities do not support it. One of the latter (W. L. Tower) says:

"Knowledge concerning the germ cells, which are the germ plasm or the carriers of it, is largely anatomical in character, derived from the studies in cytology, and in the main is one-sided, incomplete, and has been too much directed to the study of chromosomes."

The curious thing about these two contradictory views of the question is that either or both may be right. Darbishire's statement cannot reasonably be contradicted, because it has been clearly shown that the single-celled zygote is the starting point in the formation of the future animal. It is clearly observed under the microscope to multiply itself by a process of fission in the formation of body tissue; its details, minute as they are, do not evade our vision; but it

exhibits one quality of which we know nothing: that is, life. Its anatomy is clear; its functions are clearly demonstrated; but what it is that gives movement to its anatomical parts and directs them to perform those functions so unerringly is the mystery that may never be known. The potential principle of its movement cannot be explained at present, and until that can be done Mr. Darbishire's dictum can neither be denied nor affirmed. Nor is it necessary to oppose his view, except to say that the "outward characteristics" of which he speaks must surely be resultant purely and entirely on the innate potency of the germ cells themselves. That they conform in every way to unalterable natural laws is equally certain, hence those characteristics must be regarded as a safe and unerring guide in the matter of propagation. So Tower's view must be accepted also.

The ordinary breeder can find no use for a microscope in his business, so he has necessarily to fall back upon the study of "outward characteristics," and, convinced of the fact that "like begets like," he proceeds accordingly. He leaves too much to chance, however, and is too often surprised to find, in comparing his results with their immediate predecessors, that the word "like" is a very elastic term. He finds also that there is not exact equality in the "outward characteristics" of sire and son or of mother and daughter. The younger generation is either a little better or a little worse than their parents when those characteristics have been compared. In plain language, his results are either on an ascending or a descending grade, and are never on the exact level, for there is no such thing as absolute equality, and Nature never stands still. This principle may be illustrated by a graph showing results year by year.

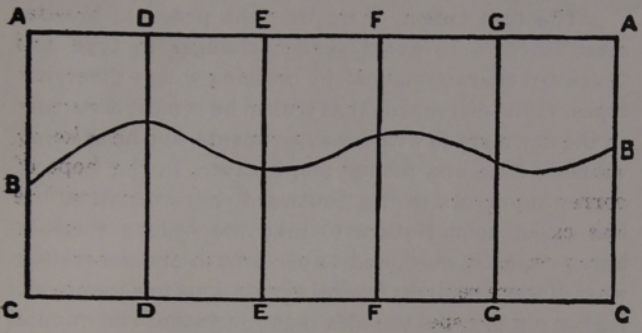

FIG. 1.

The horizontal lines A-A and C-C represent the limits of improvement and deterioration. The perpendicular lines D-D, E-E, F-F and G-G denote the successive years, and the wave line B-B the varying results of each year's breeding.

The improvement or deterioration that inevitably takes place from one generation to another is what is known by the term "variation." Sometimes it is exhibited in a very marked degree in hybrids, and to a far lesser degree in purebred animals. This is an important fact to remember, and it is well described by the German philosopher Buchner in the following sentences:—

"Incessant and minute change is one of the conditions of life. Sudden change is disease, and no change at all incipient death."

Whether it is applied to the Russian revolutions, the collapse of an organic body, the abnormal growth of body tissue, or variation in successive generations of animals, that axiom is "as true as gospel." It is clear, therefore, that the breeder who attempts to make sudden changes in his flock or herd by introducing new blood from lines dissimilar to his own animals in "outward characteristics" needs no "daylight saving" legislation, because he has already put back the clock.

The first lesson, then, that the practical breeder must learn is to avoid sudden changes in type and "outward characteristics" by crossing widely divergent types. If he disregards that truism he is most assuredly on the down grade with his experiments, and he is losing valuable time and money too, because, in the hope of correcting errors in the " outward characteristics," he has called upon Nature to take too wide a step—to hurry on, as it were, and to perform in one generation what Nature requires several generations to accomplish. He has not grasped the idea that " incessant and minute change " is the unalterable rule in healthy development, and that Nature's laws cannot be sucessfully interfered with. Far too many breeders are convinced of the notion that faulty characteristics in stud animals can be corrected in one generation. There is greater variation exhibited in the crossing of hybrids one with another than can ever be detected in crossing of purebreds of similar type. It is Nature's way of telling us that a disregard of the principle of " minute change " in the selection of animals for mating is not likely to succeed to the breeder's satisfaction. The mule may be instanced as an extreme example of Nature's longest step in this connection, and the fact that the mule is a sterile animal that cannot be induced to propagate its species only emphasises Nature's abhorrence of taking long strides.

Here we may be reminded of our statement that " our preseent stock have descended from primitive animals of vastly different structure," and it may be pertinently asked how Nature, of its own volition, has produced such vastly different types if radical change is so abhorrent to it? The answer is plain and complete, and the paleontologists have supplied it.

CHAPTER II

ANCESTRAL TYPES DISCOVERED.

THE well-established facts of geology leave no doubt on the minds of scientists that the age of this earth runs into many millions of years. Astronomers put it down at something like 500,000,000, but the geologists are content to figure it at about 250,000,000 years or less. The shorter period is more than ample for our purpose in answering the question put at the conclusion of the first chapter. It gives more than ample time for immense changes to have taken place in form and structure of anything and everything that composed the entire mass of the earth, or the organisms that existed upon it, no matter how slowly those changes were brought about. At what precise stage of its existence organic life first appeared can only be guessed at; but it is clear that if we introduce the Paleotherium magnum (the three-toed animal from which the present-day racehorse, the Clydesdale, and the Shetland pony have descended) as an inhabitant of our globe, say, five or ten millions of years ago, there is still sufficient time for the complete changes that have taken place without in the least degree hurrying on the natural process of "incessant and minute change." But how do we know that the Paleotherium did not make his appearance at a much later date? The animal himself is dead, and can tell no tales about his birthday; still there remains the most reliable evidence of the important parts of his life history and the approximate date of his nativity, though he in turn was descended from a four-toed and then a five-toed animal. All this is a

well-established fact, for the paleontologists have taken careful note of the stratum in which the remains have been found, and have fixed the date according to geological time, which fits in quite reasonably with all the requirements of the argument. For instance, the remains of the Paleotherium (which, by the way, had not only three toes, but a long snout like a short elephant's trunk) have not been discovered in more recent strata than the upper Eocene, and there is no evidence that man existed at that early period. It is quite probable that the animal referred to was never seen alive by any human being, and that the species in that form became extinct before the advent of man, because the earliest human remains yet discovered have not been found below the quaternary stratum. The ancestors of the horse have therefore been traced back to a period many thousands of years earlier than those of any other domestic animal.

All that we know of the early history of cattle and sheep is of comparatively recent date geologically. Most people are conversant with the Biblical story that Pharaoh " presented sheep and cattle to Abraham," and while it would be most interesting and instructive to know something of the type and character of those animals, all records are silent upon the matter. It has been said of ancient Roman history " in every page *locutus bos* "—that is, " in every page the ox speaks "—and Pictor (one of the earliest Roman historians) described the ground on which the city now stands as " *Pascua bobus erat* "—in other words, " a pasture for cattle "—and in Ovid we find a similar reference, viz., " *Tantaque respencis pascua bobus erat.*" So that within historic times we have ample evidence of the antiquity of the species, even if we go no farther; but there is reliable authority for stating that cattle were

domesticated in Turkestan and Central India nearly 8,000 years B.C. Even at that ancient period there was more than one variety extant and possessing quite distinct characteristics; but it is only with one of those varieties that we are here concerned, viz., the Bos urus,

(From Cuvier's "Animal Kingdom," 1827.)

FIG. 2.

The Bos Urus, or The Wild Ox of Britain.

which the evidence points to as the progenitor of our present stock, although Professor Ewart, of Edinburgh University, is credited with the statement that "examination of Neolithic (new stone) and Bronze Age deposits prove that for about 18,000 years there have been living in Europe three kinds of tame cattle, viz., polled cattle, cattle with short horns, and cattle with long horns," and that these were introduced into Egypt at a very early period and brought from Asia to Europe during the New Stone (or Neolithic) Age. Clearly this statement has no reference to the Bos urus, ages ago

extinct, because Youatt described the Urus as "of immense size and of terrible ferocity." The fossil remains of this animal clearly show that he stood quite six feet in height, with long sharply-pointed horns carried well forward, and measuring three feet six inches between the tips. There is a skull of this animal in the Cambridge Museum, with a stone axe by which he was killed embedded in the skull.

Now the most interesting thing about that fossil is that it bears a very marked resemblance to many individual members of our present-day so-called Shorthorns, that have been bred in the semi-wild state on some of the large cattle stations. The writer once had to deal with a seven-year-old wild steer that very nearly approximated the type and dimensions of the Urus, except in height and the sickle-shaped hind legs of the Urus as represented in the restored picture presented on page 9. Having regard to the enormous distance of time between the existence of those two animals, the similarity is particularly striking. Yet that lapse of time, great as it is, serves to show how very slowly Nature progresses, and how little variation takes place when a fixed strain is not violently interfered with by admixture of dissimilar types.

The fact that a human implement is embedded in the skull of that museum specimen enables us to say with reasonable certainty that the Bos urus (or, as he is now called, the Bos primogenius) existed in Britain not more than about 12,000 years ago, and as, as is authoritatively stated, he was the progenitor of the wild Chillingham cattle that exist in pure strain in some of the English parks to-day, we have a valuable and reliable object-lesson in natural variation. The Chillingham cattle are all white with black ears and tip of nose, and there is also an ancient domesticated breed

of the white Swedish polled cattle similarly marked, and known by the name of Fjall cattle. The almost

FIG. 3.
Fjall cow.

identical colouring of those two distinct breeds suggests a very potent, though perhaps a very remote, relationship, and if it could be shown that the Bos urus was also a white animal, and the progenitor of both, it would afford most material evidence on the still elusive question of heredity. Most probably such is the case, however, though there is nothing to show whether or not the Urus was white, red, or black. He may have been a black or a white, or both, and transmitted his dominant colour to both those breeds.

Quite recently, and to some extent up to the present time, there existed a very strong prejudice among breeders against any indication of the sable ear or black snip in show animals of the Shorthorn breed, and even the white colour was not favoured, possibly

FIG. 4.
White Heather.

FIG. 5.
Champion bull (beef type).

because of some fear of reversion to the original type; but that characteristic has now almost entirely disappeared from modern herds, and where it does appear it affects only the colour, and does not seem to have any influence upon the conformation of the animal bearing its mark.

On page 12 are shown typical animals of the beef-producing Shorthorn, which can hardly be excelled for shape, symmetry, and facial expression, which latter characteristic is, in the writer's view, for breeding purposes the most important feature of the whole contour; but more of this anon. Some breeders, and judges, too, might discount their merits solely on account of their colour, so the question arises, "Have these animals reverted to the Chillingham breed?" True, they show no semblance of the black snip or the sable ear, otherwise the colour all over is conspicuously like the stock from which they have so remotely descended. If they have reverted in colour they show no semblance of reversion in type, and as colour is of but secondary importance there is very little reason to discount their merits on that account.

CHAPTER III

EVOLUTION OUTLINED.

THE genetics of animal breeding and the physiological problems that are presented to the investigator and the experimenter have been described (as far as our knowledge of the subject will permit of description) in numerous books and papers. These writings are all lucid enough to the minds of trained scientists and to a limited number of breeders who have taken the pains to inform themselves as to the exact meanings of the technical or scientific terms used. To the average farmer and breeder, however, probably more than nine-tenths of that literature is not understandable; at any rate, its more subtle points cannot be grasped. This fact presents a serious difficulty to the present writer, whose object is to simplify the information available to such an extent that every dairy farmer, flock master, or pig breeder may understand and benefit by the discoveries so far ascertained. The late Professor Huxley could do that without much effort; but he had few, if any, successful imitators in that respect. Herbert Spencer, for instance, described evolution thus:

> "Evolution is an integration of matter and a concomitant dissipation of motion, during which the matter passes from an indefinite, incoherent homogeniety, and during which the retained motion undergoes a parallel transformation."

Now that definition is not only perfectly correct, but it is also quite clear to every physicist and quite a host of other people also; yet to the great majority of readers it is not even "as clear as mud"; nor would the much-prized "shilling dictionary" afford

much assistance in explaining technical terms that are constantly being added to our language. If you call an ordinary high school boy a homozygous or a heterozygous animal he might be highly offended and feel inclined to throw stones at you, yet your description of him would be quite scientifically correct; but he could not grasp your meaning. Long pedigrees are valuable, but many who can boast of them may not feel flattered if they were told the strict scientific truth that each and every individual along the whole line had their origin in gametes and zygotes.

In spite of these drawbacks, evolution is as important to every stock breeder as his milk cans are to the dairy farmer or his shearing machines to the flock owner. Darwin wrote eight volumes of books in explanation of it more than half a century ago, and many intelligent people to-day misunderstand his meaning, and many more have misunderstood the man. He was execrated for his alleged irreligious teaching, though in one of his books, the *Origin of Species*, he rebuked one of his critics by saying that such a view "would be a travesty on the works of God," which Darwin never attempted to oppose. He was a close student and observer of Nature, which he regarded as "the works of God," and his profound investigations led to the discovery of unalterable law or system in every department, whether animal or vegetable, and that system is summarised in the one word "Evolution." He collected immense masses of facts upon which he constructed the profound and now generally-admitted theory that gained for him a world-wide fame; but he never allowed himself to pry into the metaphysical aspects of things, which he regarded as going beyond the capacity of human understanding; or, in other words, he realised that the natural mind could not

transcend Nature in order to grasp the ways and purposes of the supernatural. The instincts of birds and animals he regarded in that light, and though he studied those instincts very closely as to their advantages in the great struggle for existence, he says: "I will not attempt any definition of instinct. I have nothing to do with the origin of mental processes any more than I have with life itself." Sufficient for his purpose was the fact that every living thing possesses an instinct more or less strongly developed, which enables the pigeon to find its way back home in a direct line over strange country that it has never before seen, or the blind worm to find its food in the dark recesses of the earth; that it is a hereditary faculty of Nature, and that without it the whole species wholly or partly depending upon it for its welfare would inevitably be doomed to gradual extinction. What is it but instinct that induces the buffalo to refuse to mix his species with any breed of domestic cattle unless he is bred with them from infancy? Yet the buffalo and the Shorthorn belong to the same zoological family; but Nature instinctively, and, we suppose, unconsciously too, dictates to that unreasoning beast that any such union would be at least inadvisable, and so it would be if the resultant hybrid progeny had to live the wild life and endure the hardships imposed upon the buffalo by its environment. Should not that fact alone afford a noteworthy lesson to those breeders who are endeavouring too hurriedly to produce useful hybrids with organisms that possess a dominant instinct? To be successful it is more than feasible to assume that if that trait exists it must be atrophied or crushed out by a long process of inbreeding and its environment entirely altered, for there is no other way. Even where union has been established in those wide crossings,

Nature frequently expresses its abhorrence most plainly by refusing to endow the hybrid with the faculty of fertility, and here it must be stated that infertility in thoroughbreds is not due to any such cause, but rather must it be attributed to structural or accidental defects in one or both of the mated animals.

Darwin laid stress upon the importance of environment and what he termed "natural selection." By "environment," of course, he meant the natural conditions under which the animals lived—their opportunity to get sufficient food and shelter, freedom from attack, etc., which, it will be readily seen, had a very potent bearing on the destiny of all species. The Urus became extinct notwithstanding his "terrible ferocity" and his ability to combat the onslaughts of all other wild animals in his environment, because he was hunted by man, not alone for his flesh, but also because he was a danger to human life. It is with "natural selection," however, that we are more concerned in dealing with the subject of breeding, and it may surprise many that this mental giant (Darwin) held that not only was there a process of natural selection as between males and females in their undomesticated state, emphasised by what we have said of the buffalo, but that in every stage of growth from the gamete and zygote to the mature animal the process is continued. To make this clear it may be explained that the existence of both these infinitely small specks have since Darwin's day been undeniably proved by the biologists, and are actually seen under the microscope; and it is found that the first stage in the formation of a fœtal body is commenced by the union of two cells not nearly as large as a very small pin's head, called gametes. These are dissimilar in structure, and when they unite they become a zygote, which means

a yoke. Every poultry breeder has seen the structural changes that take place in a fertile egg in the process of hatching, and that gives an excellent illustration of what takes place within the fertilised zygote, but with this difference only—that the hatching is done within the mother's body instead of in the incubator; but the process is the same. Continuous change goes on within the cell until it divides into two separate cells, those two into four, four into eight, and so on, each attaching themselves to their allotted parts in forming the body that is eventually destined to become the mature animal, directed by that mysterious law which Darwin called "natural selection." It would seem as though the cell itself possesses an instinct, which we cannot define, to perform all the natural functions that are necessary to the perpetuation of life. Chemists are familiar with the affinity that certain elements have for one another, and the repulsions exhibited by others—oil and water, for instance; but whether this is a manifestation of what we call instinct we must leave the chemists to decide. Be that as it may, there is ample evidence to show that the whole of the characteristics possessed by the mature animal originate in the gamete or the zygote, and are altered only by its environment. It is now held that even sex is determined by the gamete or the zygote, and Dr. Crew, M.D., PH.D., of Edinburgh, goes so far as to say that:—

"To a slight extent it is already possible to control the sex ratio."

And . . .

"There is every reason to maintain that within the next ten years such measures will have been devised and made available to the breeder."

That prediction may or may not be fulfilled; but if it is, it is pertinent to remark that such gross interference with the established laws of Nature may not, after all, be a profitable undertaking. Certainly, from the ethical point of view, it is not desirable. Presumably the object of such an experiment would be to limit the number of male animals (the average proportion of males to females now produced is stated to be 100 to 118); but while it would result in a vast increase in the totals of flocks and herds, it may (very probably would) result in a very undesirable diminution of market prices, except in countries possessing an unlimited range of area.

CHAPTER IV

GERMINAL INHERITANCE.

It is scarcely necessary to go into all the minutiae of animal genetics, because it would be but traversing what has already been very well discussed by the specialists, and a plethora of detail might only have the effect of confusing the minds of ordinary breeders. Besides, it is already well established that all the important factors required for the building up of the body of man or beast are contained within the zygote, which we have endeavoured to describe. Not only that, but that complex organism also contains the mysterious though potential force which controls development of those "outward characteristics" exhibited by every animal on arriving at maturity. Do those characteristics originate in the gamete or the zygote, as some biologists appear to indicate, or are they transmitted from the parents? These are vital questions, because if the first question must be answered affirmatively, then the most skilful breeder can exercise no control over them, and his care in selection is but a waste of time; he can rely only upon chance for his results, and his disappointments may be multiplied to infinity. On the other hand, it would be rash to assert that if they are transmitted from one generation to another, the characteristics transmitted by the Urus find any resemblance in the white cow illustrated on page 12. The one whose "terrible ferocity" is fully displayed in the clear expression of his eyes and face, with hind legs well adapted for the speed so necessary to his environment, the "set "of his horns, the thickness and strength of his neck, and his general contour

denote qualities quite distinctly opposite to the calmness, docility, and general excellence of his modern descendant. Yet we need not hesitate to assume that "outward characteristics" are inherited from both sire and dam: not in equal proportions, however, in the two gametes (one of which is supplied by the male and the other by the female) which unite to form the zygote. That it has taken thousands of years to effect this drastic change in type and character will now perhaps become apparent to those who have not studied the principles of evolution, and it should be an object lesson to those who are too impatient in trying to effect desired or desirable changes. Had the same environment continued, however, it is quite certain that the great difference in type between those two animals would not (we might say, could not) have been effected.

Many writers have copiously and laboriously dealt with the question of reversion (or, as many people call it, "throwing back"), but in no case is it claimed that the reversion extends over a very long period of time—generally only a very few generations. Reversion, of course, is what might be expected if our present stock were turned loose to fend for themselves, and under the conditions that obtained in the days of the Urus they would probably revert to some approximation of his original type and habits. The tendency to pronounced reversion, however, is exceptional, and in no material sense does it seriously interfere with the best methods of breeding. It is but the weed in the garden, so to speak, and should be treated accordingly. In the fixed types it is quite a rarity, and in many cases where it does occur, the evidence is not at all conclusive that it is not due to accidental crossing, which sometimes happens under circumstances that are

considered to be sufficient safeguards. No other definite or satisfactory explanation of it has been given, though the cytologists have been trying to trace its origin in the chromatin (a constituent of the zygote). All that can be said of it with certainty is that the purer the breed the fewer are the "recessives" of a marked character. The reversions or variations that are constantly occurring is what the breeder is most concerned with, and where that variation amounts to a reversion to a slightly lower type than either of the parents it may be (most probably is) due to the breeder's own misjudgment of the "outward characteristics" of one or both parents. It may also be reasonably ascribed to sudden and extreme temperature at certain critical stages of fœtal growth or to temporary indisposition of the mother, to the nature of the food, or to many other things that occur in everyday experience and are not foreseen. In the nature of things it is not to be expected that any two parents can or do produce two or more animals of equal merit, for again let us say that there is no such thing as absolute equality. To-day, Limerick is described as "a super horse," and only a few days ago the writer was asked, "Why can't we produce another Gloaming?" Limerick has probably answered that question already; but the logical answer is that the breeders of both those animals, either by accident or design, mated two mares possessing the highest merit for propagatory purposes with two horses of more than average merit, if not quite the highest, and both of the progeny fell into the hands of two of the cleverest trainers in this Dominion, who are entitled to a share of the kudos. The breeder of Gloaming did not know what he possessed, and gave away a fortune-maker for £240. We cannot produce Gloamings or Limericks with anything like confidence

or certainty upon haphazard or guesswork methods except by accident or good luck. There must be a system, because Nature works upon system or law.

Now what is that system? Every breeder believes that he has one, and every other breeder vies with the man who happens to be the most successful, and still persists in pursuing his own system; but one and all will admit that he or they can give no detailed explanation of it.

It may be pointed out here that in dealing with this subject, reference is made only to purebred animals, and that what applies to one breed applies to all breeds. Nature does not change her plans, and applies them equally to the goat as to the cow, and to the sheep as to the horse. Therefore those plans must be strictly complied with on the strictest evolutionary principles. Outcrossing for any purpose except with closely allied animals (not necessarily as regards recent pedigree) emphasises natural variations, and is always liable to result in mutations. This is especially the case in what is known as line breeding, when type and pedigree differ too widely.

Overleaf are two animals " of the male persuasion," both championship winners, and to test this question of " system " the author submitted those photographs to one of the best (probably the best) local authorities on stock and their management, and a qualified veterinary surgeon to boot, and asked him to say how he would judge them for stock purposes. Fig. 7, of course, had his preference, and he proceeded to dissect the weak points in conformation and outline from the shoulder backward (the old, old method, for none other appears to have occurred to anyone of the present generation). His criticism was right so far as it went; but, as he made no reference to what in the author's

FIG. 6.
Milking Shorthorn breed.

FIG. 7.
A successful sire with only the head to recommend him.

view was, and always will be, the one and only part of an animal's anatomy that should be studied with the greatest care and intelligence, a further question was addressed to him in these words: "Now, Mr. ——, you thoroughly understand the anatomy and the physiology of animals, and your knowledge of cytology is quite sufficient. Can you say that any one of those parts of the anatomy that you have referred to have any bearing or influence upon the genitive organs or what they produce?" Then, placing his hand upon the photo excluding all but the head, the questioner continued: "Is not that the governor of the engine, and does it not display the whole character of the animal at a glance?" He readily admitted that the legs, flanks, sides, rump, etc., had no such relation to or influence upon the progeny of the animal, and that the head alone could be the generative index; but he said, "like begets like," evidently forgetting what he had read in our first chapter on that identical point.

(Here the writer feels called upon to express his thanks for the interview, and his highest appreciation of the frank, courteous, and unbiased way in which his ideas were received and discussed by a gentleman whose wide knowledge, experience, and professional status add a high value to his utterances.)

How many people have noticed the difference between the head of an entire horse and a gelding, a bull and a steer, or a ram and a wether, and asked themselves how those marked differences can be explained, or what they mean? Why does the presence or absence of certain glands so appreciably affect the character and expression of the head, when the removal of a leg or any other part of the anatomy, except the head itself, could have no such effect. Breeders are earnestly invited to think over this question.

FIG. 8.
A champion prize-winner.

Assuming that the skin of the above animal (fig. 8) is of the right texture, there are not many judges who would be inclined to find fault with him in the show ring; but unless the photograph libels him, he displays an effeminacy in his head which is in no sense suggestive of prepotent qualities so absolutely necessary in a successful stud animal. What his record has been the author has not the most remote knowledge; but the assertion is here ventured without hesitation that if that animal ever succeeded in producing a beast as good as himself it must have resulted from a prepotent mother. It may appear venturesome to make that assertion, but experiments prove nothing and experience is as nought if what is here stated is not fact.

CHAPTER V

AN OLD FALLACY REFUTED.

BEFORE entering into the details of the system, theory, hypothesis (or whatever we may choose to call it), which it is proposed to set forth in these pages, it may be advisable to clear the air in certain extraneous matters. Whoever attempts to interfere with existing notions or usages—no matter how simple or feasible the new proposals may be—has a difficult task to perform, because he must first overcome existing prejudices and misconceptions before a great majority of people will deign to consider what any new idea may portend, or extend any credence to its merits, whatever they may be. The greatest system of moral ethics ever devised brought down upon its Founder the execrations of those who did not, or would not, see eye to eye with Him. Darwin was reviled for daring to put a new interpretation upon "the works of the Creator." On 22nd June, 1633, a congregation of prelates unanimously declared that "the doctrine that the earth is neither the centre of the universe nor immovable, but moves ever with a daily rotation, is absurd, and both philosophically and logically false, and is at least an error of faith." Up to the year 1819 the books of Galileo, Copernicus, and Kepler were forbidden, though they contained nothing more than astronomical truths, and it was not until the year 1822 that books teaching of the motion of the earth around the sun were allowed to be issued. To-day, there are no such restrictions on science, although individual prejudices are as strong as ever with a vast yet

diminishing number of people who quite honestly hold fast to old notions, and they think as they do because their fathers and grandfathers thought so. Now, those people are doing the right thing in holding on to their old convictions until something better is put before them in a manner that appeals to facts and logic for its basis, and those who will not reason things out for themselves are not acting or thinking in their own best interests.

Old platitudes often gain such a degree of credence in the minds of those who think casually that they are apt to become fixed beliefs, and the doctrine expressed in the three words "like begets like" is one of them. It has become a creed. The fact that it contains a modicum of truth ensures its preservation in stock lore, yet it is not strictly true, and for that sufficient reason alone it should never be quoted except in a qualified sense. How can it be said that "like begets like" when Daisy and Cherry, the favourite old cows of the dairy, both red and of good shape, and mated with a well-shaped red bull, each throw a black calf, or a black-and-white one—one perhaps deformed, and the other "no great shakes" as far as shape is concerned. Every farmer of experience knows that such things occur, and yet he is as ready as ever to repeat the old platitude "like begets like," quite overlooking the fact that if it were unalterably true our stock would neither improve nor deteriorate. More definite and less misleading terms are required in the discussion of this intricate problem of animal breeding.

With the last chapter appeared three photos, each of which must be taken as a typical animal of its class according to the notions of their breeders and judges, because each won a championship prize in public competition. It may seem presumptuous for

the writer to question those awards, particularly so in the Ayrshire and spotted Shorthorn; but an honest conviction compels him to do so because the heads of each are distinctly of the "recessive" character—that is to say, they are on the down grade[2] (see graph on page 5) and the progeny of neither could be expected to be as good as they are themselves. In the spotted Shorthorn's head there is exhibited a sulkiness and a surliness that clearly denote the recessive quality, and the way that head hangs down as if he were apologising for his want of vigour puts him "out of court" as a champion stock-getter, or anything approaching that standard. The roan Shorthorn, on the other hand, possesses a good head on a body that is by no means faultless as a show animal; but there need be no doubt that he would produce stock at least as good, if not better than himself, if properly mated. As before remarked, the Ayrshire is an anomaly. With his head hidden he is an attractive animal, while the femininity of that head completely destroys his value as a stud beast. Did we not see that he is a bull and not a steer, that head could easily deceive anyone. In no sense could he be classed as what is known as a prepotent sire —that is, one that is capable of improving his stock. It is rarely (very rarely) found that such a marked contrast exists in one individual, though it is by no

[2] A reader has asked "Why?" Answer: Those photographs show most distinctly that the effeminate head of the Ayrshire bull is not in any sense characteristic of males of his species, and is therefore unfit and unable to function as a truer type of head invariably would. It lacks the impetus to soar above its own standard; therefore must be classed as "on the down grade." The other animal is in the same category, though of different type. His head shows a listlessness incompatible with natural vigour, therefore most assuredly not on the "up grade." Perhaps he is tired of the show ring and wants to sleep.

means surprising or unaccountable. Emasculation has the same effect upon what we may here appropriately and correctly term "animal physiognomy," and this is the science (for it is such in reality) to which it is particularly desired to draw the attention of breeders generally. Without any desire to be dogmatic, it may be asserted that *animal physiognomy is the keynote of success or failure in breeding*, and all else is of but very secondary importance. Convincing facts in support of that assertion will presently be supplied.

Every competent breeder will be ready to acknowledge that a good head sets off to advantage the general appearance of an animal of any breed, yet, strange to say, the head is the last thing that ninety-nine out of every hundred of them will examine until they are satisfied first of all with the other points, and then only as a deciding factor when they are in doubt between two equally well furnished animals when a choice has to be made for breeding purposes. The same thing occurs in the show ring, where only breeders of the best repute as breeders are chosen to make the selection for prizes. The breeder, in all probability, will be quite satisfied without examining the head at all if the shape and pedigree suit his fancy, particularly so if that pedigree contains the name of a celebrity. The heads of females are in most cases neglected entirely (the human species, of course, excepted), though the attractive facial characteristics of the cow or the sheep are really of as much importance to the farmer, because "plain" faces in the human species are subjected to mental training which makes them attractive (sometimes irresistibly so), while the animal kingdom (or queendom) cannot possess that advantage.

On page 31 is a picture of the one-time sensational butter producer, Granny's Girl, with a head that may

FIG. 9.
Granny's Girl, a Jersey butterfat competition winner.

FIG. 10.
Lord Rothschild's champion Jersey cow, New Orleans.

be described as ideal, and one that every Jersey breeder should aim at reproducing in his own herd. And underneath it appears another, the property of Lord Rothschild, a Royal Show champion of nearly equal merit, but simply lacking that brightness of expression in the eye which Granny's Girl exhibits so pronouncedly, without any sign of nervous temperament, which, if shown, should be a disqualification for high-class stud purposes.

The picture below is inserted to illustrate the ultra-fastidiousness of some breeders. This animal is also a champion prize-winner (New Zealand) with an almost perfect head, if, indeed, it is not quite perfect, and yet the writer was told by a breeder of repute that he would reject that animal because she drooped too much at the tail, and when asked whether he thought

FIG. 11.
A Pungarehu champion.

that droop would have any effect upon the progeny he answered, "Like begets like."

Finding that that mistaken notion is so prejudicially prevalent among intelligent breeders, some hard facts are required to controvert it. Elementary physiology teaches us that the bodies of all vertebrates (including man, cattle, horses, sheep, etc.) consist of three divisions, viz., the skeleton or bony system, the muscular system, and the nervous system. It is a physiological fact, also, that the latter controls the other two, and a man cannot move a finger until his brain has first conceived the thought to do so, and conveys that thought by a system of threadlike nerves to the finger muscles, which instantly obey. Every action of the body is subject to the same law. A horse or a sheep will not eat his food until the desire to do so is first telegraphed, so to speak, from the nerve centres of the stomach to the brain, and from thence to the jaws and tongue, and when sufficient has been consumed the brain is again informed, and the action ceases. No one can make him eat more until the digestive organs have done their work. There are what is called voluntary and involuntary muscles and organs, the latter being represented by the heart and lungs, for instance, which continue to work even when the brain is inactive, as in sleep. Nevertheless, the action of the heart is subject to the perturbations of the brain when fright or punishment agitate the latter. In a word, the brain controls every action and emotion, and every part of the body. It is the governor of the engine, so to speak, and the head of the animal, particularly the eye, displays its character. It has its agents and messengers in the form of nerves distributed throughout every part of the body, and a pin could not be inserted anywhere without touching a nerve. Those

nerve-threads are really a succession of single cells, comparable to telegraph wires, for conveying messages everywhere, with the brain as the controlling battery. The muscular and the bony systems do their work quite automatically in obedience to those messages, and neither have the power to exercise any influence whatever upon the working of the brain. The true, natural, and only functions of the muscular system are to supply locomotion and protection to the body, to move the head and jaws where and how directed by the brain in the process of obtaining food and preparing it for the stomach. Neither has it any influence upon the zygote, which is admittedly complete in itself, possessing all the incipient potentiality and requirements to form the fœtal body. These facts are not denied by any competent student, nor is it denied that the zygote, at the moment of fertilisation (that is, at the moment when the two gametes unite to form the zygote) becomes an entity in itself, and as complex in its anatomy as that of the full-grown beast which it develops into. What practical use, therefore, can there be in paying so much undue attention to bone and muscle, which are absolutely functionless, either in the production or development of the zygote? That drooping tail and the four legs, too, may be chopped off without any effect whatever upon the progeny if the mother or sire could be kept in healthy condition without them. Lambs' tails have been chopped off for many decades; still, the lambs born this year have tails as long as ever. "Thereby hangs a tale."

Let the reader compare figs. 11 and 12 and he will have no hesitation in pronouncing Mr. Lancaster's cow to be a perfect model, the symmetrical shape of which completely overshadows the other in all its aspects except the head. To the one the tail hangs like a

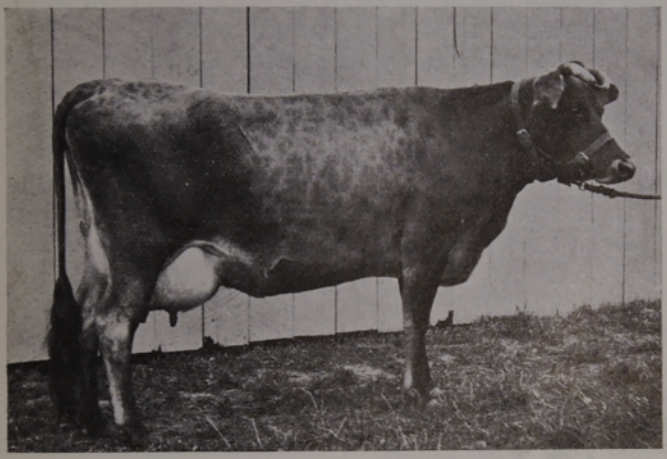

FIG. 12.
Mr. S. R. Lancaster's Neathead.

carriage whip, while in the other case it hangs like a pendulum. Fastidious judges of " outward characteristics " would view that difference with emphatic disapproval as regards fig. 11; but if the photographs were equally clear (which, unfortunately, they are not) the other ends of both animals would stand out in inverted significance, and assuming that the pedigrees of each were of equal merit, the author would not hesitate to choose fig. 11 for his stud without any thought of disparaging the character of the other, but purely from a consideration of the heads of both. Neathead is appropriately named and a beauty to look at, but her perfect tail has no advantage over the other, whereas her head shows an indication of that nervous temperament so detrimental to the exercise of the

functions natural to her tribe—especially when more pronounced.

Now compare Neathead with the world's record butter-fat producer, Plain Mary (fig. 13) with a record of 1,040lbs. of fat in one year, and it will be seen at a glance what a misleading tale " body characteristics " behind the ears are apt to unfold. Her whole weight at the end of the test was only 1,030lbs., and her name is an appropriate one too, but her head, though not a pretty one, is yet a lovable one showing character and constitutional vigour. The photo is by the celebrated animal photographer Stronmeyer, who knows how to display the essential points of any animal in his pictures. Would that other photographers would study his art.

FIG. 13.
Plain Mary, a world's champion.

CHAPTER VI

THE IMPORTANCE OF GLANDS AND CELLS.

THERE is, in the anatomy of all the animals with which we are dealing, a system of glands which, all authorities agree, have a distinct bearing upon the functions of the body. Without them those functions to which they severally relate could not be performed, and the race deprived of them would cease to exist. They do not act similarly, nor are their fluid contents alike in substance. Some are ductless—that is, with no apparent connection to local parts of the anatomy. Some are permanent; others are not, and the latter seem to become atrophied or disappear; but each and all have their duties to perform, either in procreation or the maintenance of health, etc. We do not yet know all about them, but we know sufficient to indicate their uses and functions. The thyroid glands, for instance, situated on either side of the throat in the human species, just above the breast-bone, have been shown to have a direct relationship to that very prevalent disease in women, called goitre; while of the thymus gland little is known, and we can only say at present that it bears some relationship to the generative organs, and most probably influences the early stages of fœtal growth. The important thing for the farmer to remember is that all those glands are most delicate in construction, and that the smallest injury to or interference with any of them may result in serious trouble, and that only in a completely healthy body can they be expected to perform those necessary natural functions which Nature has placed them there

to perform. One can therefore easily see why environment has such a sensitive effect upon all breeding experiments, especially during all stages of fœtal growth, seeing that a chill or a blow at a critical stage may impress its permanent effect upon the progeny, and upset to some degree the calculations or expectations of the most competent and careful breeder. It is quite a possibility that an embryonic Gloaming or Limerick may have become an expensive "duffer" through some remote and hidden cause occurring during gestation; yet it is during a portion at least of this critical period, the winter months, that dairy cattle, and horses too, are too often put away to graze on what are perhaps the coarsest and most shelterless pastures, where food is not always of a desirable quality or, it may

FIG. 14.

A money-maker reduced to poverty and helping to keep her owner on the same road. Note the wistful expression of the eyes plainly imparting the desire of her heart, viz., a stomach-full of good wholesome food. A cow in this condition cannot produce a record breaker or a show animal, her woe-begone feelings being plainly impressed upon her offspring if there be one in her womb.

be, of sufficient quantity. Hunger impels an animal to eat almost anything, and because they eat up the coarse, innutritious herbage, many (alas! too many) farmers are satisfied.

Major-General Sir F. Smith, once Director-General of Army Veterinary Science, and one of the best authorities on animal physiology, remarks: "The extraordinary importance of the endocrine glands to the genital system cannot fail to have been observed." And he goes on to describe, in language too technical for ordinary readers, the relationship that exists between those glands (some of which we have mentioned above) and the genital system, which we have also referred to in its relation to the brain. It may, therefore, be concluded unhesitatingly that our reasoning on this identical point, expressed in former chapters, is scientifically sound, and it is more than encouraging to know that the crux of the argument is so emphatically supported by such an eminent authority.

Now, if it may be taken for granted (and who can dispute it?) that the endocrine glands, the genital system, and the brain comprise the whole mechanism required in the physiological process of evolving the zygote, if it must be admitted (and who can dispute it?) that the brain is the controller of this complete mechanism, where can a valid reason be found for pursuing the old method of trying to mend the drooping tail of the cow or the flat rib of the horse by attempting to patch the defects from parts that can have no possible influence upon them? There are no bones in the zygote or the gamete, nor are there any muscles, though the fluid contents of the cells from which they are derived may or may not contain the incipient material for the future formation of both; yet it is quite certain that whether or no, being of a purely mechanical nature,

they cannot impart anything but what is purely mechanical in the process of reproduction. To put it in another way, the bony system and the muscular system are not the body builders or menders of it—they are merely the carriers, and supporters of, the body. It is the function of the brain, the nerves, and the glands working in unison, solely and entirely to do what is necessary for the perpetuation of an animal or a species, and those can be relied upon to do their work if Nature's laws are observed and not interfered with.

Since the foregoing was written a friend has placed in our hands Maj.-General Sir Frederick Smith's authoritative book, *Veterinary Physiology*, 1921, from which we take the liberty of quoting the following passages, which should leave no manner of doubt upon the minds of readers that the old method of selecting animals for propagation is futile and misleading: that the attention of breeders must be diverted from too close a study of "body characteristics," and rivetted more intensely upon cranial and facial features if they are going to get the best results in the matter of improving their stock. On pages 751-2 Sir Frederick says:—

"There are two distinct classes of cells in the body. The more numerous tissue cells, known as the somatic or body cells, are responsible for the structure of every tissue in the body, from the hardest to the softest. Another and a much smaller set are the germ cells, *which are concerned solely in the reproduction of the individual.* The somatic cells are enormously active during embryonic life, and subsequently during the process of growth. When this is completed, they settle down to normal activity, which consists in growth by process of subdivision, and are capable of repairing the worn-out cells."

Again on page 801 he says:—

"We have seen that the cells in the living organism are divided into two groups—the body or *somatic*, and reproduction or *germ* cells. The absence of blending referred to on page 799

referred solely to the germ cells, and *between one generation and another there is no continuity in the cells of the soma. The link between generations lies in the germ cells.* Modification of the somatic cells *not being heritable,* it is to the influence of natural selection *transmitted through the germ cells* that variation must be attributed."

No stronger corroboration of the author's theory need be looked for. It proves beyond all doubt (coming as it does from a gentleman whose competency is acknowledged by every member of his profession, and who has so clearly and emphatically recorded the results of his intricate investigations) that, as before stated, "it is the function of the brain, the nerves, and the glands working in unison solely and entirely to do what is necessary for the perpetuation of an animal or a species." If there is any truth at all in

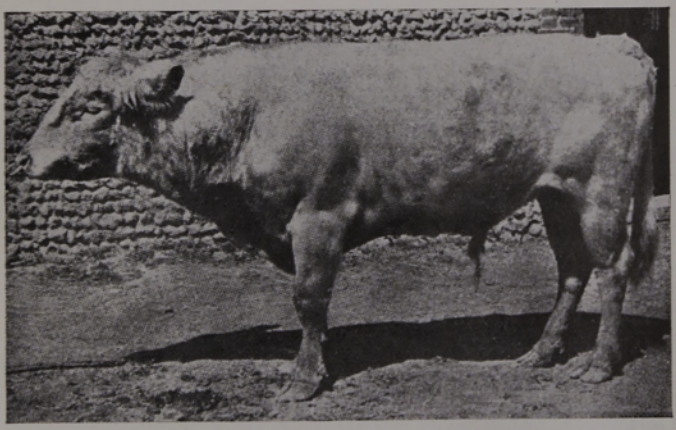

FIG. 15.

A type to be avoided.

Suffolk Golden Dun Polled Bull, now extinct. Can anybody wonder at it? He affords a good example of the extreme recessive quality. The prophetic head foretells the extinction of his race. Fate, not hunger or disease, sealed his doom.

the foregoing quotations (and we venture to assume that nobody who knows the subject and the professional status of the gentleman who has so carefully studied those cells, will think of questioning his conclusions), if there is any truth in his statements, there is but one safe and sensible course open to the farmer and breeder, and that is to turn his *main* attention to the study of the heads of those animals to be used for breeding. Why? Because, as Sir Frederick Smith clearly indicates, " there is no continuity in the cells of the soma " (or body). The animal's head is, therefore, the only reliable indicator. Fig. 15 is an example.

There remains but one more point to be mentioned in this connection in order to establish the contention that the old method of mating is wrong and ought to be superseded by something more in accordance with natural laws. If the facts submitted so far at all appeal to the intelligent breeder, he will at once see the importance of what has been termed animal physiognomy. An animal's head is an open book to any student of the subject who cares to read it. There is no exception, because every impulse, every emotion, every characteristic of his nature is there displayed with an honesty and frankness that would put the prevaricating street urchin to shame did he but recognise the contrast of his own features. Plain as the animal's features are, however, great care must be taken in the study of them, because even experienced breeders may mistake an expression of mere vivacity for that of a highly nervous temperament, which latter should on all occasions be avoided; or they confuse sullenness for determination. No cast-iron rules can be laid down for a study of this nature, and the breeder must learn from experience. Lord Sebright, the founder of the Sebright bantams—a breed which he

improved beyond his own expectations—is authentically stated to have always taken from three to four weeks of close study in consultation with a friend before he would decide upon the mating of a single pair of birds; but success generally rewarded him for his patience.

Some breeds of animals display their characteristics more plainly than others. The Shorthorn, for instance, tells its story more readily than the Hereford, and the Jersey is more easily read than either, and it is a marked characteristic of the females of all species to be more communicative, so to speak, than are the males of any species (including the human). A little practice in this branch of study would suffice to show anyone who has lived among live stock how to interpret those facial characteristics, and it need not be pointed out to them that the small effeminate

FIG. 16.

One who tells you everything.

eye of the Ayrshire bull (fig. 8) distinctly denotes a woeful want of that vigour so necessary to play the part which Nature intended him to perform, viz., to act as a protector of his tribe; nor does it, as it ought to do, give any indication of that dominance of the generative organs that must always be looked for in the male animal, for without it there is nothing else to recommend him as a stock-getter. It is not suggested

FIG. 17.
An unusually good head for his class.

here that shape or other features of an animal to be selected for breeding should be entirely ignored, though it may safely be disregarded when the head is found to "fill the eye" of the connoisseur; but if any weakness or defect can be detected in the head, all else is of no avail. The breeder's aim should therefore be to find a male with an ideal head possessing all the desirable features (admittedly a most difficult task) or the nearest possible approach thereto, and when he

has found that he should breed up to it, meanwhile keeping a good look-out for a better one.

For more than three decades the writer has been looking for ideal heads, and in male animals especially he has found very few, though there are numberless

FIG. 18

Agatha's Brookhill Fox, 69633.

Here pedigree is represented by nothing more than an average head, worth buying, it is true; but not at a fancy price, notwithstanding his high lineage.

very good ones—that of the roan Shorthorn (fig. 7) illustrated on a previous page being one of the latter. Yet the question was put to him by a prominent judge of shape, etc., "Would you breed from such an animal?" and the unhesitating answer was, "Yes, I would. Why not?" The objection to the animal was that he was "too leggy," and was slightly deficient behind the shoulder—the old story again. Now that bull has proved his merit, and his stock were, on the average,

FIG. 19.
Mr. R. W. Hudson's Knight of Danesfield.

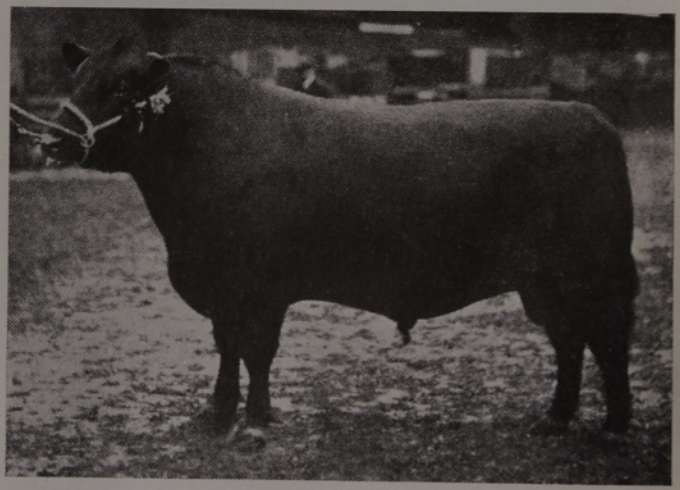

FIG. 20.
Mr. Petrie's Metaphor.

quite up to the best standard, and none was of the "leggy" type.

In fig. 19 may be seen an Aberdeen Angus head that is as near perfection as one can reasonably expect, and the owner, Mr. R. W. Hudson, should feel proud of it. Contrast that head with the Royal Show champion, Metaphor (fig. 20) underneath it. These two heads are worth hours of close study, and the breeder who fails to detect the better character of Mr. Hudson's bull has not fully mastered the science of selection by head study. He should try again and again until his own eye becomes more sensitive to slight differences.

It must be admitted that there is not a great deal of difference in the facial expressions of these two animals. The heads of both are excellent; but there is a difference in the eyes, and the pictures are inserted mainly to give the student of the subject an object lesson in the fine discernment required of the successful breeder.

FIG. 21.
Woodcrest Johanna Tehee.

It is not easy to secure attractive-looking heads among the Friesian tribe, but on the previous page is shown a picture of one that displays her quality quite plainly. Bred by Mr. John Donald of Westmere, Wanganui, she changed ownership several times, and in the course of her unusually successful career produced 2,148lbs. of milk and 714.96lbs. of butter-fat in one year. It would be interesting to hear what Show Judges comments would be on her "outward characteristics." Regarding her tail as a pumphandle for pumping milk out of the udder, no doubt her high rump would be an attractive though unusual feature, otherwise it does not conform to accepted notions of how a dairy cow should be built; but there is her head—excellent, ideal. Would they look at that and acclaim her what she proved herself to be—a queen in the realm of utility.

CHAPTER VII

CATTLE-BREEDING CONFERENCE.

IN the *Proceedings of the Scottish Cattle Breeding Conference*, 1925 (at which none but recognised authorities were permitted to express their views), appear some very remarkable statements which we take the liberty of quoting:—

"There is" (says Mr. W. F. McLaren) "one principle or physiological fact in breeding which should not be lightly dismissed, and it is a fact which was duly recognised and acted upon by Amos Cruickshank and other pioneer cattle breeders long before Mendel discovered his law of inheritance. It is that the best individual may not turn out to be the best and most consistent breeder."

Quite so. Every breeder of experience must have noticed that. It is just what must be expected from a wrong system of selection. In all probability Mr. McLaren had seen the prize animal—the Ayrshire bull (fig. 8) whose photograph appears on page 26 to illustrate that identical view of the question—and he may have had that animal in his mind's eye when he dealt with the matter; but neither he nor any other speaker at that conference attempted to offer any satisfactory explanation of why such things occur. Neither did he nor anyone who took part in the discussion suggest any adequate remedy. Mr. McLaren, however, attempted to give an explanation when he said:—

"His surface qualities may be the outcrop of what are known as the recessive characteristics, the factors for which were born in the germ cells of his progenitors, and if this is so, his prepotency in breeding will be a minus quantity."

This is hardly the explanation one ought to expect from a high authority on breeding. In the first place, his hearers were left to guess what was meant by the expression "surface qualities." He says they may be the outcrop of "recessive characteristics born in the germ cells of his progenitors." But surely, if they were "surface qualities," they could easily have been detected, and the animal at once deprived of any chance of being called a "best individual" without waiting a year or two for him to prove his failure at the stud. If he was dealing with the animal referred to, the cause of failure was quite plainly depicted in the effeminate head.

In giving expression to those statements, Mr. McLaren was but following the commonly adopted notion that body cells as well as germ cells are hereditary. Major-General Sir F. Smith says it is not so, and until that fallacious belief is abandoned by breeders, they cannot advance very far in unravelling the mysteries of breeding. Indeed, this conclusion is made clearer still by Mr. McLaren's advice "to adopt what the biologists call genotypic selection," and this, he explains, "consists in breeding not necessarily from the best, but from the best breeders conforming to the type required," though that is not precisely what the biologists themselves mean by the words "genotypic selection." What, then, is the method of selection? Is there not here a frank admission that what are regarded as the "best" animals are not always "best breeders," and that present methods fail to indicate "which is which" until those animals are tested by actual experience? The advice is sound as far as it goes; but it is at best a dilatory method, and one that must necessarily be an expensive one. Something better is required, and it is available to breeders who will take the trouble

to inform themselves of correct principles and avail themselves of the information supplied by scientific investigators such as the one above quoted.

Another authority hailing from Chicago, Mr. Wentworth, Director of Armour's Live Stock Bureau, told the same conference that

> "In general, prepotence depends on four genetic phenomena: (1) dominance, (2) homozygosis, (3) the supplementary interaction of heredity and developmental factors, and (4) the linkage of genes."

That sounds very learned, precise and authoritative; but then, what does it mean? In the first place, the man who can separate "dominance," as commonly understood by every intelligent breeder, from "homozygosis," as used by the biologists, and which means practically the same thing, is really too profound for ordinary intellects to follow; but for the first time we learn that heredity is "supplementary" to anything. If it is, it is not of a hereditary nature at all, for the word itself implies the prior existence of something transmitted. If by "developmental factors" he means the thymus glands, the nature and action of which little or nothing is known with certainty, one can get a vague idea of his meaning; but what useful corollary can be derived from guesswork such as that?

Equally mystifying is his fourth postulate, "the linkage of genes," unless he was dealing solely with the production of hybrids, and even in that case prepotence does not "depend" upon the "linkage," rather is it weakened thereby, or, as often happens, absolute infertility is the result. If Mumtaz Mahal and St. Simon or Cyllene and Ornament (whose pictures appear in Chapter VIII) were mated, there would be no "linkage of genes," because all four animals belong to the same

genus. How can any ordinary breeder learn any useful fact from literature such as that we have quoted above?

If we are to reach the maximum of excellence in the breeding of animals of any genus we will gain nothing by soaring into poetic language or highflown technological terms to express our meaning. We must come down to hard facts and experience, leaving those who enjoy the exercise to take their flights wherever their fancy leads them. Adam Lindsay Gordon has entertained thousands with his poetic description of "How We Beat the Favourite," but his very clever poetic stories give no suggestion of how to produce another Gloaming, a Limerick, a Carbine, or a Phar Lap. Others, of a more practical turn of mind, have dived into the literature on the subject, and some (a comparative few) have endeavoured to apply the experiences of the most successful breeders and the investigators to their own methods of breeding, generally with disappointing results. Conferences have been held and all phases of the subject discussed *ad libitum*, until at last we appear to have reached that point where we have learned to know how little we do know. Even to realise that is a distinct advantage, and a long stride ahead of the time when it was thought that the few very successful breeders knew all that was required to be known. Now we know what they knew and how they worked to achieve their successes, and we know enough also to make us hesitate before following in their footsteps too slavishly. We have found that the two Cruickshanks and Bakewell, the most successful and oft-quoted pioneers, resorted to a severe system of inbreeding, which had the temporary effect of improving their flocks and herds, but also had the effect

(inevitable, but unforseen) of weakening the constitution of the animals they bred. Youatt says of them:

> "The breeds had acquired a delicacy of constitution inconsistent with common management."

Quite probably those men were compelled to breed in and in for lack of suitable sires; but to-day there is no such excuse, nor is there the need either, for of two equally dominant sires of the same type and similar pedigree, the one closely related and the other distantly related to the mare, there is no logical reason for choosing as her mate the one that is closely related.

(From Mr. Charles Richardson's new book on The Horse.)

FIG. 22.

Bend Or, sire of the unbeaten Ormonde.
A much-admired type, generally voted to be perfect.

CHAPTER VIII

THE EQUINE BREEDS.

THE antiquity of the horse has been already referred to, but not until comparatively recent times has there been much attention paid to its development or improvement. It took some time after its first domestication to discover that any improvement was necessary, or that it could have been effected. The Arabs may have been the first to make this discovery, but that they set about it in anything like a practical way is open to very grave doubt, for the reason, probably, that the camel, owing to his superior natural equipment for transporting heavy burdens over vast reaches of desert lands was far superior to the horse. Nevertheless, the Arabs became more and more attached to the horse as time rolled by, and adopted him as a member of the family, so to speak, and cultivated a fondness for him that is quite pathetic. This resulted in a complete change of environment for the horse, and led quite naturally to a very accurate assessment of his qualities and capabilities, and also to a more careful selection for breeding purposes, until the Arab horse at last reached that stage of perfection unsurpassed in that time by any other of his species. His owner, of course, had no idea of scientific breed improvement, and had to content himself with maintaining, as best he could, those qualities which he fondly cherished as perfection in type, speed, and stamina.

In ancient Rome the horse was not regarded with such affection as among the Arabs. He was of much heavier type and used almost solely in the amusements

FIG. 23.
St. Simon (unbeaten).

of chariot racing, and for war transport, but his fame has not been handed down to posterity with any claims to super-excellence. The Romans treated their horses more as machines, while the Arab always looked upon his as a friend, and treated him accordingly.

We have little knowledge of the type and character of the English thoroughbred at the time when the Godolphin and Darley Arabians were introduced into England, though we do know that if any records or pedigrees of them were kept, those records were very incomplete and unreliable, based almost entirely as they were, upon individual opinions. An immense improvement, however, was effected by the introduction of those two Arab horses, and in a very few generations

thereafter we find the sensational Eclipse dominating all others of his race, and most probably also had the effect of concentrating public attention upon the methods of breeding. Though those methods doubtless were then somewhat crude and unscientific, they were distinctly advantageous, because the outstanding merits of Eclipse focussed attention to the advantage of breeding from the best. As a sire, however, Eclipse performed no miracles, a fact that can be easily accounted for owing to the heterogeneous strains merged within his anatomy. He was not, strictly speaking, a pure-bred animal. From his Arab ancestors he, no doubt, inherited sufficient purity of strain; but the doubtful genealogy of his English progenitors leaves quite a lot to be taken on trust. So we have in him a good example of what is known to-day as "line breeding," too much favoured by present-day breeders who do not fully appreciate its retarding influences on family improvement. Line breeding, like the mixing of chemicals, alters the whole substance of the progeny to a greater or lesser degree; but whether for better or for worse no one can tell with certainty. Professor Sir Ernest Rutherford (now Lord Rutherford, to whom the author, though but a very casual acquaintance, takes this his only opportunity of joining most heartily in New Zealand's unanimous congratulations for this latest of the many distinguished honours conferred upon him) has shown that the shooting off of one electron from the tiny molecule of an element alters the whole element into another element distinctly different, though the eliminated electron weighs not a million-millionth of a gram.[3]

[3] For a more complete explanation of this principle the reader is referred to Appendix I.

FIG. 24.
Cyllene, sire of four Derby winners.

Hitherto there has been no attempt to apply the science of physics to that of physiology, yet there must be an indirect, if not a direct, connection to which Lord Rutherford's very wonderful experiment gives a clue, but as we cannot advance beyond the limits of our present knowledge we must content ourselves by logically examining what we do know and applying to the problems under consideration the conclusions arrived at, and if our reasoning is correct our conclusions will not be far from the truth.

So, to return to the subject of improvement, we know that, as old-fashioned methods of breeding were discarded and something better took their place,

improvement was the result. With the introduction of the Stud books, for example, every breeder could be sure that he was not line-breeding when he wanted to breed pure stock. This and other results of experience —whether accidental or otherwise it is difficult to say— have culminated in the appearance of first-class animals far above the average. To give but a few: Barcaldine, never beaten on the Irish (where he was bred) or English turf; Ormonde, St. Frusquin, and Persimmon (all three in one year), St. Simon, Cyllene, Bend Or, Minting, The Barb, etc., in England; and also Sceptre, Pretty Polly, and others of the weaker (sic) sex. While in New Zealand, who will forget the outstanding merits of Traducer, Musket, and Soult, or Carbine, Nordenfeldt, Night Raid, and others as sires; and Carbine, Martini Henry, Limerick, Gloaming, and Phar Lap as money-coiners on the course. Besides this galaxy of merit we have had numerous horses in this country that were never allowed a chance to prove their merit at the stud, their services being confined to nondescript mares of impure strain, yet still they showed that they could and did produce gallopers that won stakes in what is known as good company. Traducer and Musket themselves, and Soult, also, were for a time despised by breeders who must have grievously regretted their mistakes when they found later what gems they had allowed to escape their grasp; while numerous instances might be quoted of high-pedigreed horses being used that never produced anything worth the fees paid for their services. The fleet-footed Achilles, possessing a good pedigree, affords an outstanding example of this, but he proved a sad failure. There was not in the English Stud Book (according to the late Major Walmsley, one of the

FIG. 25.
Night Raid, sire of Phar Lap, Nightmarch, etc.

greatest authorities on pedigree that it would be possible to find anywhere), a more aristocratic pedigree than that of Anteros, but compared with Musket, who occupied an adjoining box at the Sylvia Park Stud Farm, he proved a failure also, although he looked a perfect model in which no one could find a fault, except his head, a pretty one though markedly an effeminate one.

The study of pedigrees has been, and possibly still is, the breeder's chief occupation in making his selection for mating. Therein everything is revealed that can be shown, then why are so many so often deceived? Is it not that pedigree does not supply an index to the

FIG. 26.
Phar Lap in racing trim.

heritable factors of either sire or dam, whereas the heads of each, if properly interpreted, tell the whole story most plainly. Every picture of a sire shown herein gives the clear expression of prepotency; (Phar Lap of course is not a sire, which is regrettable) and all have proved their high value by actual test, and it is regrettable that we are unable to include those of Traducer, Musket, Carbine, and two or three more that were on the list intended for publication. Where can a more dominant head be found than that of St. Simon, who left his indelible brand upon nearly all, if not all, his progeny, as did also Traducer and Musket.

Night Raid's head is a picture of perfection, and that of his celebrated son, Phar Lap, makes it lamentable that, as a sire, his counts for nothing. Of course, the breeder who knows his business will be careful to guard himself against disappointment and loss by taking some trouble to ascertain the purity of the strain in sire or dam, and that both are in perfect health; but if he overlooks the character of the head, he neglects the most important item in breeding.

It is a fearful breach of etiquette to have dealt with the male sex first and to have given precedence even to such "Peers of the Realm" as St. Simon, Musket, Traducer, Night Raid & Co. before noticing Ornament, Mumtaz Mahal, and Sceptre; but the excuse is that the etiquette of regal halls never descends to that of the stable corridors even where equine queens reside. Ornament, of course, claims first attention, not only on account of her high lineage, being a full sister to Ormonde, and dam of Sceptre, but because her head is a model, and that is all that need be said about her here, except to point out her concave back and stumpy-looking fore legs, neither of which faulty "outward characteristics" were inherited by her renowned daughter, Sceptre, who was only twice beaten in her career on the turf, though in one of those defeats (her second in the Derby) there were good reasons why she was beaten, and she always beat that great performer, Rock Sand, whenever they met. Her price in the sale ring as a yearling was £10,000.

Unlike Sceptre, Mumtaz Mahal was never beaten. Note the unusual spread of her fore legs, a point which most judges would not admire in a racer; however, she proved her speed; and her head, though not the ideal type of Ornament's, is yet a good one.

FIG. 27.
Ornament, dam of Sceptre and full sister to Ormonde.

Of the many thousands of animals that have been bred on pedigree alone, an enormous proportion have not reached the standard of excellence expected from their pedigrees, and in every case where they have reached it, a correct reading of the heads of their parents would clearly explain the mystifying problem, and the causes of the failures also. This point may be arguable in the present state of public information; but argument with a man of fixed ideas would be but a vain endeavour to reach the truth. The sure and unerring test is experiment. Let him try it as the author has done so often, and if he does, it is safe to say that his views will be changed and that he will become a pronounced animal physiognamist. The

student of this subject will find, on examining various heads of dominant animals, that there is some distinctive difference in shape or type clearly shewn by a comparison of Ornament's head with that of Mumtaz Mahal, clearly traceable to the haphazard methods generally adopted in breeding hitherto, when pedigrees occupied the breeder's chief attention, and "body characteristics"—not those of the head—were supposed to be heritable. It is quite certain now that such an idea was, and is, entirely erroneous, so when breeders generally adopt the infallible method of head study and place "body characteristics" in their true biological category as negligible qualities, the differences now so common will gradually disappear, and the thoroughbred horse will assume his true and permanent type. Then, and not till then, we will cease to hear the oft-repeated phrase uttered: "they run in all shapes," and something like reliable uniformity will be established, to the advantage of owners as well as to that of the horse and his breed.

As a clear evidence that animals are not properly gauged for stud purposes, it may be mentioned that St. Simon, on the death of his owner, notwithstanding his brilliant turf successes, was sold at auction for £1,600. Musket came to New Zealand on ridiculously easy terms because English stud masters would have none of him. Night Raid was allowed to leave England, and Australia later, at a mere fraction of his real worth. The purchase price of yearlings, too, displays a woeful lack of judgment in selecting the best. Gloaming was sold by his breeder for 240 guineas; Phar Lap at even a smaller price; and if Limerick had been put up for sale by his breeder it is safe to say that somebody would have secured an immense bargain. On the other hand, huge prices are given

From Mr. Charles Richardson's new book on The Horse.

FIG. 28.

Sceptre, only twice beaten.

for animals that prove of little value. Is this the result of pedigree deception, or inability to gain any useful conception of "outward body characteristics"? The so-called experts should be able to provide a satisfactory answer; but they do not. "They run in all shapes" is not the solution of the problem.

From the foregoing it must not be inferred that high-class pedigrees are to be despised, or even neglected, because they are clear evidence of that homogeneity which distinguishes its possessors from the scrubs and hybrids, and ensures to the breeder a measure of safety in the perpetuation of type. Yet, as

a factor in the success of breeding experiments, pedigrees occupy a secondary place, their chief merit being that pure lineage reduces the chances of pronounced variation. Nevertheless, the stud books of horses, cattle, and sheep have contributed more than their due quota to the successes that have been attained, simply because they afforded the breeder the information that he desired in order to escape the semi-hybridisation of his stud, which would have been inevitable too often without those records. In this connection it may be said that the Bruce Lowe system had also its value at a time when confusion of blood and confusion of thought were more general than they are to-day, for it helped to systematise the methods of breeding. Never has it proved to be an unerring guide, and the usefulness it once possessed is rapidly passing away. The same may be said of Mendelianism, which showed us the dangers of straining Nature's laws and taught us that the "go slow" policy in breeding is an imperative necessity.

There were no stud books in the days of Eclipse, nor were there any chronograph stop watches to check the speed, and his pedigree is more authentic than his performances, as no comparison can be made that can throw any light upon the improvement that has taken place during the interval. The neglect to time records on the English turf is astounding in a country where there is so much close attention paid to other details, so that all that can be said is that improvement has been effected, although the alleged mile-a-minute record has not even been approached. So it can be seen that what we are doing is not purely scientific, and the highest standard of speed of any horse can only be gauged by comparison with that of some other individual whose standard is just as indefinite. What

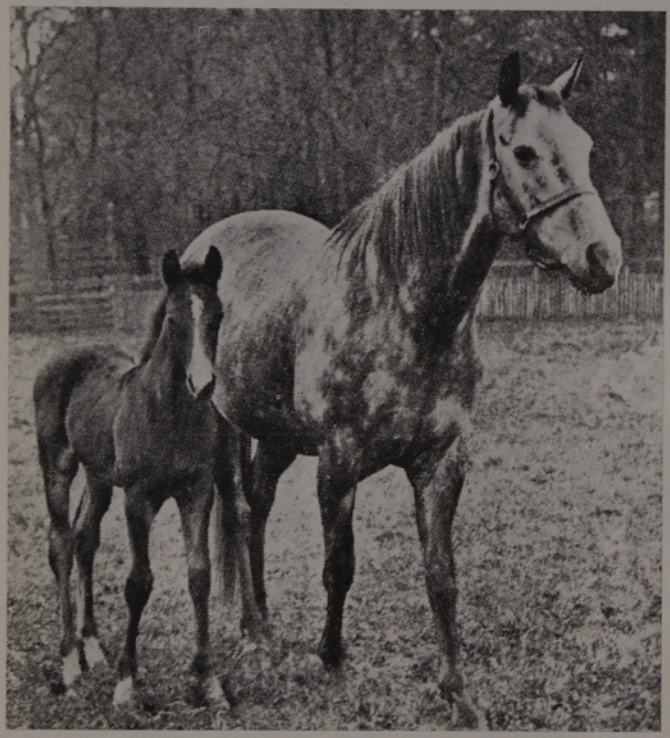

FIG. 29.
Mumtaz Mahal (unbeaten).

we do know of a certainty is that the modern racer can run away from the purebred Arabs from which he has descended. The Americans are more practical in this respect, and every "reinsman" who sits behind a "pacer" carries a stop watch on his wrist and knows the pace he is travelling as he passes every furlong post. The pure-gaited trotter that not so long ago ornamented the brougham and the dogcart is rapidly disappearing, and unless public taste and conditions are altered, may soon become as extinct as the Bos urus.

In fig. 31, on page 70, we have a horse, perfect in type according to the modern notions of Clydesdale breeders; but let us analyse this question without prejudice. Is he the perfect type? It may seem heretical to doubt it, but it must be remembered that the perfect type of any animal is the one whose conformation and capabilities most nearly accord with the highest standard of utility, of the purpose for which he is bred. As a picture this horse is perfect. There is no gainsaying that; but we cannot overlook the fact that producing pictures for an artist's guide is not the real objective. The purpose for which he was bred, and his mission in life was to work between the shafts and pull heavy loads on every grade of road. Naturally, therefore, one should look for a conformation best suited to that purpose. Does this horse's conformation comply with those requirements? For some unaccountable reason, Clydesdale breeders and judges admire the sloping shoulder, and a slight trend of the hocks towards each other with the hind toes turned a little outward. The sloping scapula would be undoubtedly a most admirable and advantageous feature in the hunter so as to prevent over-reaching, and to induce the elevation of the head to see over an obstacle when galloping towards

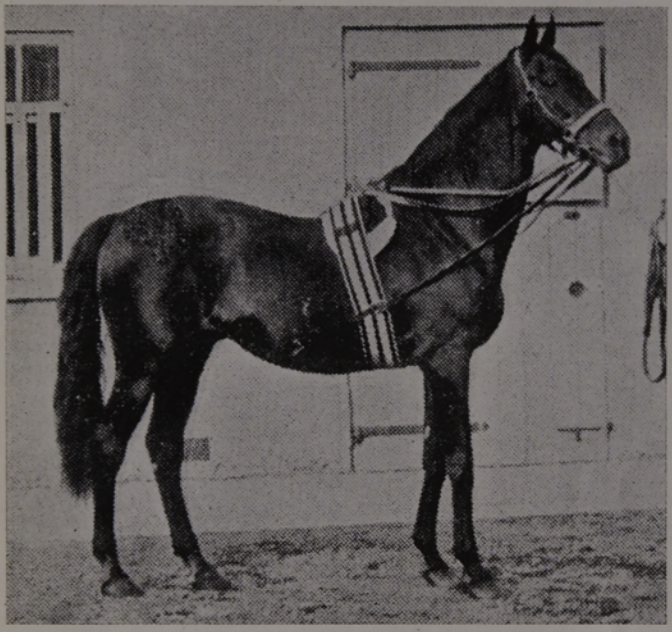

FIG. 30.
St. Simon at 21 years.

it. The outward trend of the hind toes and the corresponding "cow-hocked" formation may have their advantages in the square-gaited Yankee trotter when going at top speed; while in the Clydesdale (except for appearances) these points have no practical utility or advantage whatever. Judging from the photograph on page 70, Baron's Pride does not show any tendency to the cow hock or turned-out toes. All the better, because every draft-horse, without exception, instinctively turns his hind toes *inward* when straining at his traces. Why,

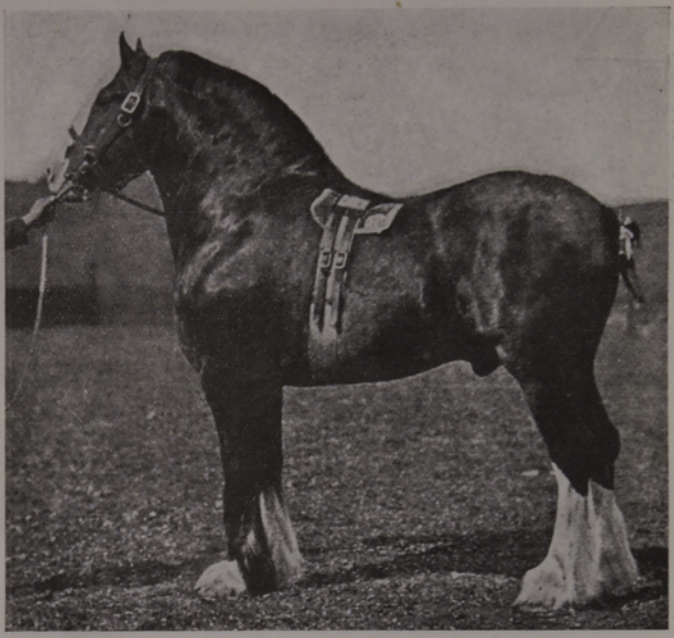

FIG. 31.
Baron's Pride, said to be the finest Clydesdale ever foaled.

therefore, should we try to produce a type to counteract the dictates of Nature, and to alter the natural and best-adapted physique required in the performance of the work to which the animal is put? It would seem sacriligious, almost, to alter the very fine picture which Baron's Pride presents; but utility is, or ought to be, the breeder's main consideration. Now let us see whether he can fulfil that condition. As he stands, he shows a slope of shoulder amounting to a defect for the purpose of drawing loads. This point will be readily seen if a line is placed to represent the exact

slope of the scapula or shoulder blade, which would also represent the slope of the hames in actual work. Then assume that the traces, in order to give the horse his fullest chance of exercising his pressure on the collar as equally as possible above and below the hame tugs, should form a line as nearly as possible at right angles to the hames, so that the point of the shoulder would be relieved of the main pressure and the lower muscles relieved also. But to effect this mathematical precision in his case the traces would have to be attached laterally to a point on the ground near his hind hoofs. Traces are usually attached horizontally or nearly so, and the inevitable effect on this horse must be to render him incapable of exerting his full strength in pulling. Not only that, but on going up an incline the collar would be dragged upward against his windpipe with a choking effect, and at every step rubbing the point of the shoulder, and that is why so many horses suffer abrasions on the lower parts of the shoulder. These facts should surely convince breeders that even the perpendicular shoulder, though not so attractive to the eye, has its advantage over the extreme slope now, unfortunately, so popular. Extremes should always be avoided.

CHAPTER IX

A NEW DISCOVERY IN WOOL-GROWING.

IN the year 1927 the Victorian Government issued a pamphlet purporting to set forth "Aids to Selection of Rams," and "Characteristics of Australian and British Breeds of Sheep," by N. A. Bowman, sheep and wool expert, in which illustrations appear of twelve different breeds of sheep, including the Romney, the Corriedale, the Ryeland, and the English and Border Leicesters, with descriptive matter and "points" to be considered in selecting the several types. If those photographs are to be depended upon as illustrative of the best of Australian breeds, the first point to strike the New Zealand breeder would be the marked superiority of his own animals, particularly the Lincoln, English Leicester, and Romney, though he might hesitate before claiming superiority in Merinos. It is, however, the page devoted to "Aids to the Selection of Rams" that most attracts our interest. It is worth reproducing in full rather on account of its omissions than anything new that it contains, so here it is:—

THE ESSENTIALS OF A SIRE.

"The first consideration in the selection of a sire is to be assured that he is purebred, that is, chosen from a purebred flock. The reason for insisting that a ram must be purebred is that a nondescript or mongrel animal has not the power of transmitting to his progeny the characteristics of the breed he is supposed to represent.

"Secondly, he must be of sound constitution; in other words, there must be no tendency to disease. He must have both width and length of body, a well-sprung rib, and depth at the shoulder and girth. His general appearance should be one of symmetrical proportions.

"Thirdly, a sire must present a bold masculine appearance. Generally, the head is a valuable indication of type. A ram with a good, bold look gives one the idea that he is fit to be the guardian of a flock.

"Fourthly, he must be covered with a good fleece of wool, even in quality, and true to the type required of the particular breed. If the sire be of the Merino, Polwarth, Corriedale, Lincoln, Border Leicester, English Leicester, or Romney Marsh breed, a crimp (undulations or waves seen on the wool fibre) should show through the wool. This crimp must be even and well defined; this denotes character.

"Fifthly, he must be free from any trace of hair or kemp. This fault should be particularly looked for towards the breech. It is more liable to be found in Merinos, Polwarths, and Corriedales than in other breeds.

"When selecting sires for wool-producing flocks, on no account should "density" (compactness of growth) be forgotten. Quantity as well as quality counts very considerably.

"If the intention be the raising of fat lambs, the purchaser should endeavour to obtain a sire as firm in the flesh as possible. Such a ram should get a better class of lamb. He should be long, deep, thick, with a straight, strong back, and have style, vigour, and masculine bearing. For ordinary flock purposes, conform as closely as possible to the standards set for his breed."

It will be seen from this that this expert makes no mention of the head, except for ornamental purposes and "as an indication of type," "generally," and its value otherwise is summed up in the indefinite phrase: "A ram with a good, bold look gives one the idea that he is fit to be the guardian of a flock"—fighting dingoes, for instance, when the flock is attacked by those predatory carnivora. If that is the sole purpose of the

FIG. 32.
Four-horned blackfaced rams.

head of the ram, Australian breeders might try their luck with the four-horned rams here depicted, and as the ewes of that breed wear the same cranial ornamentation, some success might follow the experiment.

The best use we can find for rams' heads is what has been indicated in former chapters; but we should remember that "bold" heads in rams are quite foreign in their nature, nor could the boldest of them scare the most pensive dingo. In this Dominion we have no pestiferous dingoes, so we can afford to allot to our animals' heads their proper use—not that of defence, for it is safe to say that if sheep had not been domesticated thousands of years B.C. and protected by man, the species would have been devoured and become extinct ages ago, because they are by nature so unobtrusive and defenceless. Notwithstanding this expert's

FIG. 33.
English Leicester ram bred at Lincoln College.

claim, the Corriedale is not an Australian sheep, though the hybrid Polwarth, bred from the Merino and Lincoln (like the Corriedale), is an Australian of less merit, and the English Leicester (as shown in fig. 33) bred by the Canterbury Agricultural College, may be taken as a type to follow until Australian experts realise the proper use for their sheeps' heads, both male and female.

Notwithstanding the marked success of New Zealand sheep breeders, the writer has met with only one (though no doubt there may be a few others) who paid much attention to heads in selecting breeding animals, and that was the late Mr. John Bidwell, of Pihautea Station, Featherston, who was good enough to issue an invitation to inspect his Romney flock. This

invitation was gladly availed of, and in the discussion that ensued when the writer remarked, "Never have I seen a better lot of flock rams, with beautiful heads, every one," Mr. Bidwell replied, "You've hit the mark. When I want to choose a ram I push his head through a fence, and I don't want to see any more; and," he added, "I have been working on that plan for ten years." He could not explain why, except that he had noticed that the best rams and the best breeders were those with the best heads, and he had found it a good plan to follow. It must have been a lucrative one, too, for Mr. Bidwell's flock rams were at that date all booked two years ahead at a price about five guineas above the ruling market values, and they were well worth it. Had it been possible to get his opinion upon that English ram (shown in fig. 34) sold for £1,000 and afterwards exported to the Argentine at £1,600, it is safe to say that he would not have gone into ecstasies over him as a stud animal. His eyes do not recommend him.

The next photo (fig. 35, page 79) presented to the writer by the owner, Mr. George Allen, represents as good a head as could be desired. When a hogget, this animal was rounded up in the corner of a paddock with seven others, and the owner had decided to part with him, but, on the advice of the writer, he was retained, and another selected for sale in his stead. Over two years later, to express his thanks and pleasure, the photo was presented, with one also of his stud Romneys, the animal in the meantime having proved his merit both at the stud and in the show ring.

This incident occurred in 1911, and the author has just learned from Mr. Allen that what prompted him to send the photos mentioned was the fact that a son

FIG. 34.
English Romney, sold to Argentine at £1,600.

of this ram (Uniform II, fig. 40) won for him the hundred guinea cup at the Manawatu Show in 1914, being adjudged the best ram in the Show. Fig. 41, another direct descendant of Uniform II, was champion ewe at the Royal Show, Christchurch, 1925. Other successes have also been scored by this line, and more will yet be heard of them.

Before proceeding further with sheep-breeding it may be advantageous to point out that certain scientific investigations made by the late Professor T. Brailsford Robertson, immediately before his death in Australia, throw an entirely new and interesting light upon the question of wool production. We know, from

experience, that correct breeding has an important bearing upon the quantity and quality of wool produced. We know, also, that climate and bad feeding interfere with wool growth and its quality. Professor Robertson has attacked this problem in the true scientific spirit, and apparently has discovered a sound and infallible method of producing greater weight and higher quality of wool irrespective of climate. Taking into account the "break" and hairiness in some wools, he set himself to discover its cause and remedy. Everyone knows that "break" in wool has a most damaging effect upon its market price, and that to increase the quantity without first removing the defect would be but poor compensation for the trouble and expense of doing so. He satisfied himself that very dry seasons increased the occurrence of "break" in the fibre, and that its occurrence corresponded with the period of dryness, irrespective of the quantity or quality of the food consumed. Analyses of wool, hair, horns, and hoofs showed that each of those things contained a high proportion of cystine (but whether cystine is a compound or an element is not stated). After further exhaustive research in the analysis of grasses, etc., he found that the highest proportion of cystine was obtainable from yeast; but as brewers' yeast, the only source of supply available in required quantity, was distasteful to sheep owing to the presence of the bitter taste imparted by hops, it had to be discarded in the experiments. The analysis of waste products from the slaughter yards—hoofs, horns, hair, and wool gave a high percentage of cystine; these things are indigestible, and therefore unassimilable by animals, but when subjected to partial hydrolysis by hydrochloric acid at high temperatures, they could be reduced to liquid form assimilable and utilizable by the animals

FIG. 35.

Bred by Mr. Geo. Allen, Tipue, Carterton.
Retained by owner on the advice of the author. Sired the winner of the Hundred-guinea Cup and Championship at Palmerston North Royal Show; himself a championship winner also, together with his progeny (figs. 37, 38, 39 and 40)—in all, ten championships and cup to date.

for the production of wool. The investigations did not end here, however, because the actual effect of increased cystine supply had to be ascertained, as well as the most economical method of obtaining it. Further exhaustive research revealed the fact that all plants of the *Ficus* group contained a high percentage of cystine, but the problem still remained unsolved on Professor Robertson's regrettable death how to utilize

these products commercially and economically in the form of licks in such a way that the animals will make ready use of them. The experiments have clearly demonstrated the high value of the protein; and the stage already reached in this direction is distinctly encouraging. Further advances will have to be made before cystine will be available to the sheep-owner as a commercial article; but if the remaining difficulties can be overcome (which at present seems more than likely) the introduction of a cystine content with sheep diet promises to revolutionize wool production, and its effect upon breeding will also have to be considered. It is almost certain that the effects of climatic conditions can easily be overcome. Here, then, is a clear indication to farmers that science properly exploited by competent brains (as opposed to the pseudo-scientific muddling of would-be scientific investigators now, alas! too common) can relieve him of most of his troubles, and that he should appreciate the difference in value to himself between the one and the other. Actual results will prove to be his unerring guide.

CHAPTER X

PROMINENT BREEDERS' VIEWS.

A breeder of Romneys, Lincolns, and English Leicesters of more than ordinary repute is Mr. W. Perry, of Penrose, Masterton, whose type of sheep is well known to the writer, who has viewed them for a succession of years in the show pens, though he has never had the pleasure of the owner's personal acquaintance. A mutual friend, however, is responsible for the information that Mr. Perry is one of the extremely few who pay any attention to heads as a guide to selection for mating, and his excellent type of stud sheep lends more than probability to the assumption that he does pay some attention to that feature of the subject. Yet in a paper which he wrote for the Board of Agriculture (of which he has been a member since its inception) under the heading "Principles of Live Stock Breeding" 1923, he makes no reference to that phase of the question. He says:—

> "It is with a feeling of diffidence that I consent to give an opinion on breeding of stud animals. The experience I have had has been wholly with long-woolled sheep, and I am of opinion that the methods that will work out quite well when breeding Merino sheep, on account of their purity and evenness of type, will not be satisfactory with long-woolled sheep."

No one who knows a Romney, a Lincoln, or an English Leicester sheep, and who has seen Mr. Perry's most excelent samples of those breeds, would dream of suggesting that any of them possessed the least tinge of impurity, and they all "breed true," because the type is now sufficiently "fixed." If, therefore,

FIG. 36.

Here are three very fine three-shear rams bred by Mr. W. Perry, Penrose, Masterton. From the woolgrower's point of view they can hardly be excelled; but for stud purposes No. 3 is the superior animal. The photograph has disqualified No. 1, otherwise he might possibly take first place. Contrast the eyes of No. 2 and No. 3 and you have a plain and infallible lesson in selection for stud purposes. No. 3 shows plainly the desirable dominance and vigour of constitution so essential to success. Mated with ewes of undoubted vitality, No. 2 might produce better than the author would expect from him, while No. 3 might be expected to keep up or improve his standard under any fair circumstances, provided his organs are not overtaxed.

there is any undue variation in his successive results, as his statement suggests, its cause must be sought in another direction. May it not be found in his own words? In one paragraph he says:—

"Undoubtedly close breeding or keeping within the same blood is the only way to produce great and valuable sires; but there are limitations beyond which the breeder must not go."

And in another paragraph he asserts, in italicised type:—

"Line breeding with distant strains of the same blood is the ideal system."

It is difficult to reconcile those two statements, for both cannot be right, nor does he offer any indication of how "close" or how "distant" the strains ought to be, and he sums up his conclusions in these words:—

"To be successful at stud breeding, a person must have a natural gift for observing the good and bad points, and the general characteristics of each animal."

This makes it clear that Mr. Perry does not adopt the same methods as Mr. Bidwell has done for so many years, and Mr. Bidwell's flock, when the writer saw it, was a picture of evenness unsurpassed by any Merino flock.

"General characteristics" did not trouble Mr. Bidwell at all. He realised the value of the natural indicator of what the genetal system was likely to produce, and he tersely expressed it in the words already quoted: "Push his head through the fence and I don't want to see any more." It was, in fact, the remarkable evenness of his flock rams, particularly their heads, that first attracted the writer's attention. Incomparably more even were they than any Merino flock he has ever seen, notwithstanding the alleged

FIG. 37.
Stud ram Boniform, winner of four championships.

FIG. 38.
Stud ram Mark Twain, seven championships.

excessive purity of the latter. If further emphasis on this point were necessary (and it ought not to be in the face of the facts adduced in these pages), we have it from the pen of Darwin himself when he wrote:—

"Generic characters are less variable than specific characters."

So we may reasonably assume that Mr. Perry has been unconsciously studying the "specific characters," i.e., the body characters, rather than the "generic characters," i.e., the head and its generic connections. This is further supported by his statement:—

"A good sire in either the Lincoln or Romney breeds must have a lasting fleece, that is, it should grow good wool until four or five years old."

If that dictum is correct (and we venture to dissent from it), the stud breeder cannot safely use his rams until they are "four or five years old." That would make breeding of Romneys and Lincolns a bit expensive, inconvenient, and tiresome. Numerous prominent breeders' methods to-day do not differ very esentially from those practised by those pioneer breeders, Buckley, Burgess, and the Bakewells, of whose flocks it has been said, "they appear to be of different varieties." What else could have been expected? "Variation" had not been sufficiently studied and its causes made clear in those days, and the total disregard of the "generic characters" as well as the undue attention given to "specific" ones could have no other result than in an emphasised "variation."

How many breeders know to-day that there are two distinct classes of cells in the body, each performing different functions in the process of procreation and body-building? These are the somatic or body cells that have no act or part in reproduction, and the germ

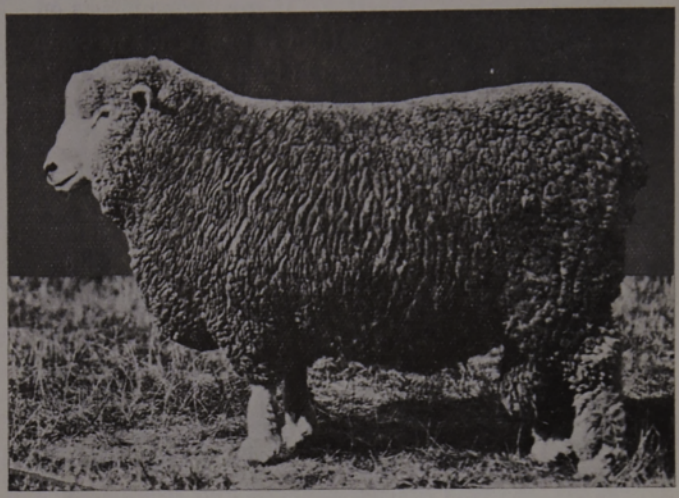

FIG. 39.
Stud ram Marcus Marks, one championship.

or reproductive cells that have no act or part in the process of bone, muscle, or wool or hair production.

Where, then, can be the wisdom of judging the results of the work done by the one in order to discover how the other is likely to perform its functions? Nature has allocated to each its special job, and both are controlled and directed—not one by the other—but by that mysterious law called "natural selection." In a healthy body both are "go slow" workers; but neither loafs at its job, nor can either be induced to "chuck it" for a "smoko" or some other equivalent. They are constant workers, and *Festina lente* (make haste slowly) is their motto.

"The points in which all species of a genus resemble each other, and in which they differ from

allied genera may be attributed," says Darwin, "to inheritance from a common progenitor, for it can rarely have happened that natural selection will have modified several distinct species in exactly the same manner."

This clearly explains the difference between the Bakewells' and the Buckley and Burgess sheep, and as we are still slavishly following the methods of those old pioneers in principle, if not in actual fact, our problems, instead of becoming clearer, are becoming more mystifying. Modern research has thrown a flood of light upon the subject, but the wide gulf that exists between the scientist and the farmer has continued to stay our progress in the practical application of the knowledge gained. One farmer wants to produce wool and mutton from each of his animals, while another wants an abundance of beef and butter from his. Hence the crossing and hybridisation of both breeds without much gain to either. The varying of prices in those commodities is responsible for this condition of things, and the farmer who tries to keep up with the market should not forget that it takes only hours or days to effect changes in prices, whereas it must necessarily take years to effect the desired changes in his animals, even if he can succeed then. Darwin has something valuable to say on this point also:—

"If nourishment flies to one part or organ in excess, it rarely flies, at least in excess, to another part. Natural selection is continually trying to economise every part of the organisation. I think this holds true to a certain extent with our domestic production."

The noted German philosopher, Goethe, expresses the same truism in these words:—

"In order to spend on one side Nature is forced to economise on the other."

FIG. 40.
The Hundred-guinea Cup winner.

An animal's whole body, hoofs and horns included, is composed of fourteen only of the eighty-eight known elements that constitute our entire globe, carbon, oxygen, hydrogen, and nitrogen being the main constituents, with calcium phosphorus and sulphur in lesser quantities; and the balance is made up of sodium, chlorine, flourine, potassium, iron magnesium, and silicon in very much smaller quantities. These elements are, of course, all in combination, and are derived entire from the food or fluid consumed. Now a drop of water is expressed by the chemical formula H_2O, which means that it is composed of two atoms of hydrogen and one of oxygen; but an animal's body contains 72 per cent. of oxygen and only 9 per cent.

of hydrogen, consequently it is not all water, because those two gases can only combine to form water in the proportion of 2 to 1, so there could exist only a proportion of 13.5 per cent. of water in the body outside the stomach, because the hydrogen is limited to 9 per cent. if we calculate by the number of molecules; but as the atomic weight of hydrogen is only 1.008, and that of oxygen is about 16, and there are two atoms of hydrogen to one of oxygen, it follows that by weight we have eight times more oxygen than hydrogen in water. The percentage of hydrogen being 9 and oxygen 72, or eight times, therefore shows than an animal's body contains over 80 per cent. of water. The importance of this fact to the farmer is that, so much pure water being required in the body if health is to be maintained, stagnant pools should be eliminated from the farm. Curiously enough, the amount of carbon is limited to 13.5 per cent. also, while of some of the other elements only small traces are found; but they must be there in order that the proper chemical combinations to form flesh, bone, sinews, etc., are maintained. Thus it will be seen how necessary it is that animals should have a sufficiency of proper food and water at all times. It explains also that wise provision of Nature of absorbing those necessary elements and discarding all superfluities. Oxygen is the most invigorating of all those elements, and it is not only taken into the stomach in water or food, but is also absorbed into the blood by way of the lungs, proving the necessity for well-ventilated stables and clean cow bails unpolluted by a filthy atmosphere.

The different products that we acquire from animals—wool, meat, or milk—are each and all made up of some of those elements in different combinations, and as the total is constant, it stands to reason that

FIG. 41.
Champion Romney ewe, Christchurch Royal Show.

if the system draws upon one or more of them to form milk, it can only be done by reducing the quantities required to form fat, wool, or meat. If extra supplies of either are required, they can only be supplied by absorption through the stomach, but there are proper limits to the amounts which that organ will supply.

No farmer can succeed in getting what he wants unless he studies these problems for himself, for animal husbandry is like chess-playing. The man who can think correctly can play chess successfully, and the farmer who can think correctly can the more easily surmount his difficulties. Each of his animals is a metaphorical pawn or piece on his chess board, each requiring somewhat different treatment, while the

whole work together, if properly directed, will achieve for him the success at which he aims. His own part in that work is first to establish a sound plan, fix his ideal of what that plan should aim at, and work up to it. The plan, of course, must conform to his resources and opportunities and, though disappointments may beset him, if he persists and plays the game, success will sooner or later reward his efforts. His game must be soundly played, however, and its ever-varying aspects and what they portend studied with care before making his move to combat any threatened difficulties. In short, every animal breeder must "use his head and study his heads," maintain health and vigour in his herd or flock as he would in his family, remembering that his animals will not cry like the baby when something goes wrong; but they show it mutely in the eye or skin, in their movements or drooping ears.

Avoid the sluggish or sullen disposition and the nervous and excitable temperament, though this latter can be improved by kindly treatment.

Look for intelligence and vigour in the eye and masculinity without coarseness in the heads of the male animals, and the motherly expression associated with kindness and brightness in the females. The alert ear as well as the eye will assist him to form his judgment in this respect.

The correct reading of those features depends to some extent upon intuition; but "practice makes perfect," and when the farmer has developed that intuitive knowledge in himself he will have no hesitation in admitting:—

"Ah! now I can tell in a minute
The reason for all you have said,
For the heart has no passion within it
That is not engraved on the head."

APPENDIX I

VARIATIONS, MODIFICATIONS, AND MUTATION.

WHEN the foregoing chapters were published in serial form in two metropolitan papers, they, of course, did not escape criticism, especially by professional gentlemen who, from the very nature of their calling, should know something about cytology and genetics. It was more than gratifying, therefore, to the author to discover from this criticism that he had launched a new scientific theory on the much debated yet little understood subject of animal breeding, and to find that farmers and breeders who had read those articles accorded to them their most hearty approval.

Among the professional criticisms of the many received by the author there was only one who ventured anything like destructive comment, and it is perfectly clear that he had either not taken the trouble to study the principles involved, or that he never did know anything about them. The others all confined their remarks to a general approval or to suggestions for alteration in the method of presentation; but in no instance were the facts as presented in the text as it stands questioned by anyone—the only complaint being that the scientific details had not been sufficiently elaborated.

The author is more than thankful to all his critics, and as he never had in view the object of pleasing everyone, his mind was set to the task of introducing a new and useful scheme of animal propagation for the farmers and breeders, who alone are vitally interested in the subject. Science to them, generally speaking, is a sealed book, and has been treated so accordingly. Nevertheless, the welcome and very friendly comments of hypercritical scientists should not be ignored, so it has been decided to attempt some elucidation of what appears, from the criticisms, to be a rather wide-spread want of accuracy in assimilating discovered facts relating to the differences and trend of what are known as modifications, variations and mutations. Though a departure from the general theme of the text, this involves the use of technical language which cannot well be substituted by simpler terms, and therefore invites misunderstanding, except from the advanced students of science, who must all know the

differences that exist, but yet fail to appreciate the importance of them.

Variations are divided by Professor Newman into four groups or classes: morphological, physiological, psychological, and ecological.

Morphological variations are differences in size and form, and these in turn are either meristic or homeotic variations, a distinction which it is not necessary here to follow out in detail.

Physiological variations are differences in quality and performance, such as differences in hardness of bone or hoof, richness of milk, in normal colour, in resistance to drought, frost, or alkali.

Psychological variations are differences in mental traits and their definite effect upon physical conditions, such as nervousness.

Ecological variations are those differences between individuals that result from their fixed relation to the environment.

All these differences are due to one of two causes. Either they represent something specific in the germ cell, or they are merely the effect of external stimuli upon the individual soma. If the former, they are inherited, while in the other case they are not. This is Professor Newman's dictum, not the author's, and it coincides exactly with Major-General Sir Frederick Smith's statement already quoted. Variations are constantly occurring in every department of nature. Even our own bodies are not the same in appearance compared with what they were a few years ago, so it cannot surprise anyone that in successive generations there must necessarily occur greater and still greater variation from the original stock in each successive generation, even though the strain is kept pure and closely inter-related. Nature will not reproduce an exact replica of any animal or plant.

Modifications are described as non-heritable differences between the individuals of a race, caused by the unequal influence of different environmental factors, and as such they have little or no bearing upon the question at issue.

Mutation is understood to-day to mean emphasised differences that occur in the abnormal condition of the chromosomes, due to what is called chromosomical aberration, gene or factor changes, chromosomal segregations and re-combinations involving lethal factors, or permanent injuries to the whole germ cell. But from whatever cause differences between animals arise, we have the undeniable fact that there is less variation and modification noticeable in the blending of pure, healthy strains than are observed in the crossing of unrelated individuals of mixed strain, or hybrids.

Attention has been drawn to the fact that each and every genus has its fixed and characteristic number of chromosomes; but we find that the horse has 26 while the ass has 24, the same as the genus homo, though the horse and the ass belong to the same zoological family, and when united they produce the hybrid mule with 25 chromosomes, and the explanation is offered that the sterility of the mule is due to its "having an odd number," instead of the explanation given in this book. This is by no means convincing, because in the first place Morgan has shown that changes in genes occur in Drosophila without outcrossing and with no appearance of hybridisation. Again, it has not been proved that an odd chromosome means sterility or that an even number in each of two distinct species even remotely suggests any modicum of homogeneity between them. The man and the ass have an equal number (24); but that fact does not even remotely suggest that because it is so the man, or many of them, often exhibit asinine proclivities, especially in his earlier stages of development. The one hypothesis is just as reasonable as the other, and has equal scientific fact to support it. In the case of the mule the existence of an odd chromosome and the sterile quality of the animal may be due to what may be described as an aberration of chromosomal activity, which is an attempt to upset Nature's infallible law of "*incessant and minute change*."

APPENDIX II

IF there is anything on earth about which more controversy has raged, or in regard to which opinions differ more widely than those expressed about the horse, it would be difficult to find it. Every groom, jockey, stableman, trainer, and a large number of blacksmiths are ready to express their opinions at every opportunity, and in picturesque language, on the horse. Some of these expressions may be sensible enough; but though most of them do not accord with science or logic, it is generally on the subject of breeding that the most ludicrous statements are made. Whether it be breeding, racing, jumping, or pulling a load, everything that is written about a horse is read with eagerness; but when a racehorse is mentioned the writer has to be very careful to keep within the limits of fact. Even then he is not too safe from adverse criticism, and it is in this connection, and this only, that the author has been confronted with anything approaching adverse criticism. No competent writer objects to fair comment if it is courteously expressed. On the contrary, he welcomes it because it is by sensible discussion that the truth is most easily arrived at, especially so when technical considerations are involved, as in this case. It would be wonderful indeed if fifteen columns of news print could be written and published by anyone on such a contentious subject as animal breeding without drawing forth adverse comment from someone. Singular to relate, however, the following verbatim excerpt from a letter written by a doctor of veterinary science, who has been for years endeavouring to breed a first class racehorse and has not yet succeeded, has fallen into the author's hands:—

> "The remainder about picking an animal with his head through a fence is all rot, pure and simple. Would you buy the best-headed cow you ever saw without seeing her udder and other parts, or a draft horse without seeing his feet in action? Of course like begets like, to a large extent, in spite of what he says. Soult had the worst legs in the world, and his stock were the same. Catmint has the best head I ever saw but his feet are rotten, and so are most of his stock. Was there ever a worse-headed horse in New Zealand than Quin Abbey, and yet, with an opportunity, it would have taken a Martian or an Absurd to beat him as a sire."

With the consent and approval of the recipient, the following letter was addressed to the writer of the above, and, no reply having been received for nearly a month, a further letter was dispatched, as below:—

Dr. ————, V.M.D.,
Dear Sir,

Your friend Mr. ———— has been good enough to read to me a portion of your letter to him in which you very emphatically condemn my articles on "Live Stock Breeding" which, I understand, he submitted to you for an opinion. I do not know whether or not you desire that letter to be treated confidentially, and therefore I do not feel justified in the meantime in dealing publicly with your statements; but if you will be good enough to grant me that privilege, I am more than eager to discuss the matter with you in the interests of breeders, you being so far the only adverse critic I have discovered.

I intend to publish those articles in book form throughout Australasia, and my chief desire is to avoid error; hence my appeal to you to expose any and every error you can find in them. I care not how you express yourself. You may call them "all rot" or anything else you like, and you will run no risk of ruffling my feathers, provided you support your statements with facts, as I have done. If you can convince me that I am wrong, that book will never be published, and there the matter will end so far as I am concerned; but please remember that platitudes and bald assertions, no matter how emphatically expressed, cannot be allowed to take the place of logic or truth, unless they are solidly based thereon.

In the interests of the country the matter is of sufficient importance to justify you in going to some trouble in this respect.

I am, dear Sir,

Yours truly,

J. A. CONNELL.

Dr. ————, V.M.D.,
Dear Sir,

Reverting to the subject of my letter to you dated 19th December, 1927, permit me to remind you that so far I have received no reply. I can hardly imagine that you could characterise my thesis on breeding as "all rot" unless you honestly imagined that you had some grounds

for that opinion. If you have, I am anxious to hear what it is; if you have not, surely courtesy demands an admission from you to that effect.

Failing a reply, I will be justified in publishing this correspondence as an addendum to the book which I am about to publish. Again let me say that all I desire is a fair discussion in the interests of truth and the advancement of the science of live stock breeding.

Yours truly,
J. A. CONNELL.

Then came the extraordinary reply:—

Dear Sir,

You seem to think that you have the right to call upon me for my opinion of your writings on "breeding." I have no intention of expressing my opinion on same. I did not reply to your first letter because I considered it impertinent. It is true that Mr. ———— left with me a bundle of papers and asked me to give him my opinion thereon. I have done so, and that ends the matter as far as I am concerned.

Yours truly,
(Signature).

The author does not feel called upon to remark upon the discourteous tone of the above letter from his critic; but when an accredited veterinarian ("qualified" is not the appropriate adjective to use here) sees fit to condemn and misquote a thesis which he evidently does not understand, some protest against misrepresentation is clearly justified. Nowhere is it stated in this book that diseased animals should be used for propagation. Nowhere has it been hinted that the head should be the *sole* index to an animal's fitness for stud use, and it has always been spoken of as the *main* indicator of prepotency—the indispensable one. "Put his head through a fence and I don't want to see any more" are the late Mr. Bidwell's words—not the author's, and if our emphatic friend would only copy Mr. Bidwell's example he might yet succeed in breeding a good horse. This gentleman's opinion of the heads of Soult, Catmint, and Quin Abbey is quite negligible in view of his other erratic expressions, and Quin Abbey's head was by no means what he represents it to be. Like St. Simon's, it is not a pretty one; but one, nevertheless, that

expressed dominance and character in every feature. Musket's, too, was a very plain head which our critic would probably not hesitate to condemn in his picturesque language, while Anteros and other failures had pretty heads which would doubtless appeal to his misguided fancy. "Like begets like," he says. Does he still imagine that the somatic cells are heritable, and that Sir Frederick Smith knows nothing about the subject? Can he deny Sir Frederick's authoritative statement that the body cells are *not* heritable? If he cannot, what meaning can he ascribe to the old obsolete platitude that "like begets like"? On the contrary, Sir Frederick Smith asserts that the germ cells alone are the transmitters of character, shape, size, and quality from parents to offspring, subject only to interference or retardation by environment or disease, or the quality of the food available. It has never been assumed by the writer that breeders are such arrant fools as to select for breeding purposes animals that show any taint of hereditary disease or constitutional weakness, there fore he did not think it necessary to stress that point. His wildest dreams could not suggest to him that it was worth while filling up his pages with such elementary information, seeing that what has been written was intended for the perusal of intelligent breeders (V.M.D.'s not excluded).

We sincerely hope it will not be regarded as "impertinent" to reiterate the fact that horses and mares afflicted with congenital malformation (sometimes very pronounced) in their structural anatomy have produced progeny with no semblance of the defects of the parents, and that cows with big well-formed bags have been the parents of most indifferent milkers. Such instances are innumerable and undeniable. What is the reason? Will the old shibboleth "like begets like" explain it? Never: but Sir Frederick Smith's dictum affords the only clue.

INDEX.

Printed by Thomas Avery & Sons Limited, New Plymouth

Connell, J.A.

The Breeding of Live Stock

Forsyth	22.6.53		