By DR. JAN BONSMA

Functionally Efficient Herefords for the Future and... How to Select Them

Hundreds of American Hereford breeders heard the talk and witnessed the demonstration given by Dr. Jan Bonsma last summer during the series of 10 reproduction clinics conducted throughout the United States under sponsorship of the American Hereford Association—but other thousands did not. For their benefit, especially, this discussion by Dr. Bonsma is presented.

Born, reared and educated in South Africa, Dr. Bonsma is head of the department of animal science at the University of Pretoria, Republic of South Africa. He has appeared before beef cattlemen in many countries, and his uncanny ability to detect by visual appraisal evidence of fertility and reproductive efficiency first came widely to the attention of cattle breeders of the United States in 1964-65 when he was visiting professor at Texas A. & M. University.

He developed his keen ability to "read" cattle with remarkable accuracy during a period of more than 30 years of study and through measuring more than 20,000 cattle and then correlating their physical characteristics and their fertility records. Checks of the records after his demonstrations have revealed him to be up to 95-percent accurate.

THE OBJECT OF STUD Hereford breeding is to produce seedstock for the commercial breeders to use in breeding better commercial cattle.

The commercial breeder's function is to produce as much red meat per unit area as possible at the lowest cost possible without detriment to the natural pasturage.

The most important factors influencing cost of production are:

1. Fertility—(high calving percentage).
2. Low mortality—(adaptability).
3. Heavy weaning weight—(good milk production).
4. Rapid growth and low food-weight gain ratio.
5. Good conformation—(a high percentage of expensive cuts).
6. Animals with a placid (calm) temperament which make management easy.
7. Longevity.

The following table clearly illustrates how calving percentage and weaning weights influence the cost of production of weaner calves:

TABLE I.

Production Cost/Pound Beef

Operating Cost—$70/Cow

Weaning Weight Lbs.	450	425	400	375	350
% Calf Crop	405 lbs.	382 lbs.	360 lbs.	337 lbs.	315 lbs.
90	17.2c	18.3c	19.4c	20.7c	22.2c
	360 lbs.	340 lbs.	320 lbs.	300 lbs.	280 lbs.
80	19.4c	20.5c	21.8c	23.3c	25.0c
	315 lbs.	297 lbs.	280 lbs.	262 lbs.	245 lbs.
70	22.2c	23.5c	25.0c	26.7c	28.5c
	270 lbs.	255 lbs.	240 lbs.	225 lbs.	210 lbs.
60	25.9c	27.4c	29.1c	31.1c	33.3c

TOP FIGURE—Lbs. of Calf Produced Per Cow
BOTTOM FIGURE—Cost Per Lb. of Calf.

Judging livestock for functional efficiency has as its aim to select cows that are potentially highly fertile and that will produce an abundance of milk to raise a heavy weaner calf.

In this paper it is my object to first indicate how I would judge the cow to determine whether she is functionally efficient.

Every cow is a challenge to me with regards to her "case history." It is the object to indicate her past, present and future by judging and interpreting the "living picture" I see before me; her external morphology is the "tell-tale" picture story.

Every picture tells a story and every cow is a jig-saw puzzle—a complex and composite one. Every section of this puzzle is a chapter in a "live" book. The judging is based on applied physiology and endocrinology.

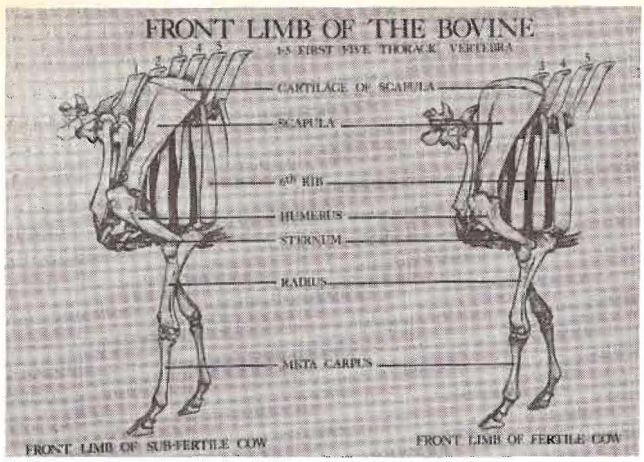
The five major sections or chapters of this story are:

1. Skeletal development.
2. Hair and hide.
3. Fat distribution and deposits.
4. Muscling.
5. Temperament and behaviour.

At the moment of conception the complete genetic potential of the animal is laid down. The interaction between the genetic potential—that is, the fertilized ovum and the total environment interacting upon it—is responsible for the ultimate morphology of the animal.

The environmental factors which influence the ultimate morphology of the animal are, first, prenatal influences—such as nutritional status, endocrine function and hormonal balance of the dam. The postnatal development of the new-born animal takes place in a most orderly fashion and is influenced by its internal environment, that is, its complete hormonal function, factors influencing its physiological reactions and the external environmental factors such as nutrition, temperature, light, radiation, altitude, wind, atmospheric pressure, disease, external and internal parasites, soil fertility, soil pH, rainfall and humidity.

Each of these external environmental factors has a direct influence on the total metabolic function of the animal and excess stress of any external environmental factor, immaterial of which one, has as its ultimate result chronic



This scale drawing shows the bones of the forequarter of a sub-fertile and a highly fertile cow. The longbone of the front limb of the sub-fertile cow is longer than that of the fertile cow. So are the front ribs and the spinous processus of the thoracic vertebra.

malnutrition. Any form of malnutrition adversely influences the normal physiology of the animal which goes hand in hand with hormonal disturbance and endocrine imbalance.

Any hormonal disturbance or endocrine disfunction is reflected in the external morphology of the animal.

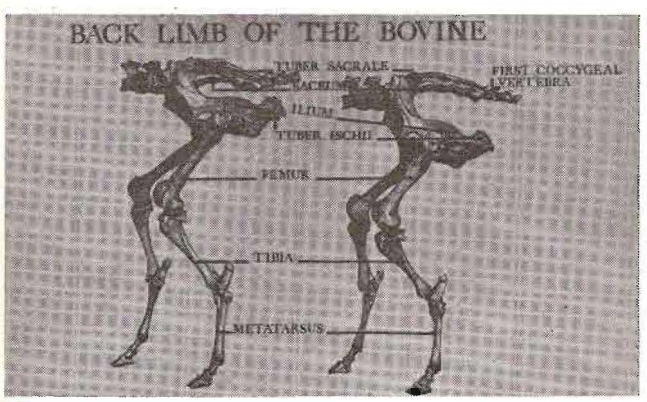
I. The first morphological concept to be interpreted in any animal is its skeletal development. Bone growth is influenced by age, nutritional status, hormonal balance, sex, etc. The rate of growth is hormonally influenced and just prior to puberty we get what is called the pre-pubertal spurt in growth. Any hormonal upset during that period and the period immediately following puberty has a very marked influence on the shape of the skeleton and the relative position of bones towards one another.

The bull that has been castrated at a young age, that is, pre-pubertal, has a completely different skeletal development to that of a bull that was castrated at two years of age. The intact bull's skeletal development differs from that of any steer. In the same way the skeletal development of the highly fertile, virile bull differs from that of the sub-fertile or eunochoidal bull.

The sub-fertile or malnourished female has a delayed puberty and in many ways her skeletal development differs from that of the highly fertile female in the same way as the steer's body conformation differs from the bull's.

We have to realize that skeletal development is largely hormonally or endocrinologically controlled.

In the judging of cows we must consider the influence



Left drawing shows back limb of dystocio-prone cow, that is, one which has difficulty in parturition, while at right is a similar drawing of a normal-calving cow. These illustrations also serve to indicate how much smaller the pelvic opening is in the sub-fertile cow.

of the sex hormones (gonadotrophins) and especially estrogen on the ossification of the epiphysis, or growth points, of the long bones.

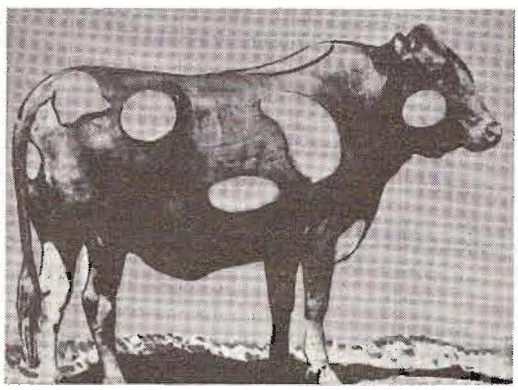
The relative position of the long bones such as the metacarpus (shank), radius (upper-shank), humerus (shoulder-bone), and scapula (shoulder blade) towards one another and towards the sternum (brisket) and the spinous processus of the thoracic vertebrae (chine) depends upon the age at which the heifer reaches puberty and has her first calf.

The sub-fertile heifer exhibits the following characteristic deviations from the highly feminine heifer:

(a) The head of the highly fertile heifer is fine, it is not coarse or steery, and the lower jaw is relatively light. The head of the sub-fertile heifer or cow is coarse, the lower jaw or mandible is heavy and is often "overshot." The body of the mandible remains cartilaginous throughout life and the only factor which keeps it under control is a normal hormonal balance. If the normal gonadotrophic hormone secretion is upset and if too little estrogen is produced the body of the mandible will continue to grow and will give the "overshot" heavy lower jaw impression.

The long bones of the sub-fertile heifer are appreciably longer than those of the highly fertile, really feminine heifer.

The fore ribs of the sub-fertile animal are long and flat. The spinous processus of the first thoracic vertebrae also



A low fertility cow on which most of the characteristic fat deposits are marked in white.

grow in length, the front ones more than the rear ones, hence such an animal develops a real rising chine.

The composite picture produced by elongated spinous processus, elongated flat front ribs and a forward and downward pointing sternum is an animal with tremendous depth through the chest. Depth of chest relative to length of body is so often overstressed in the judging of females, especially by English and South African judges.

The legs of the sub-fertile animal are also longer than those of the fertile animal. Every long bone in the front limb of the sub-fertile animal is longer than that of the fertile animal.

The bones considered are: (a) The metacarpus or cannonbone; (b) the radius or upper-shank; (c) the humerus or shoulder bone; (d) the scapula or shoulder blade; (e) the front ribs, especially the six anterior ribs; and (f) the spinous processus of the first six thoracic vertebrae.

The bones of the hind limb, especially the metatarsus, the tibia and the femur (thighbone), are longer in the sub-fertile animal than in the fertile one.

The height at thurls (the articulation of the trochanter of the femur in the ilium) is usually higher in the sub-fertile animal than in the fertile one.

The length of body, that is, from the pin bone (tuber ischii) to the point of the shoulder (humero-scapular

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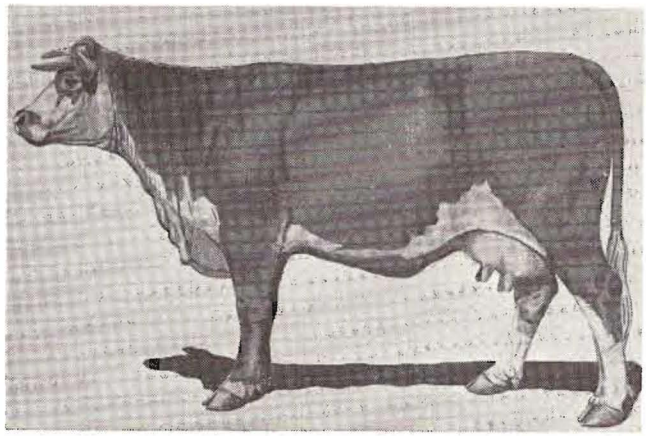
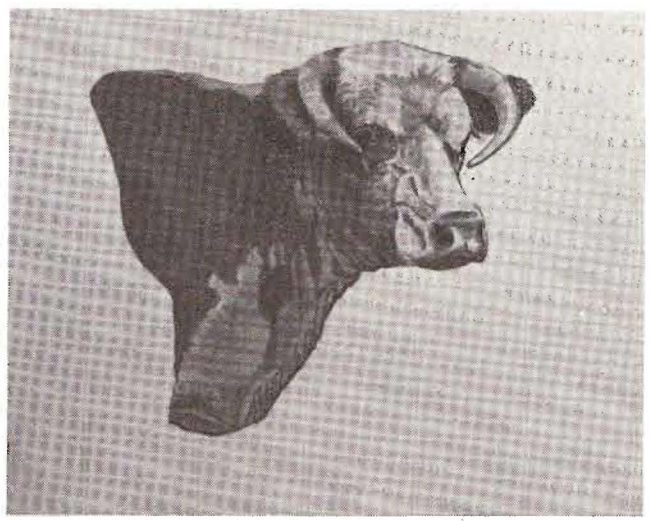
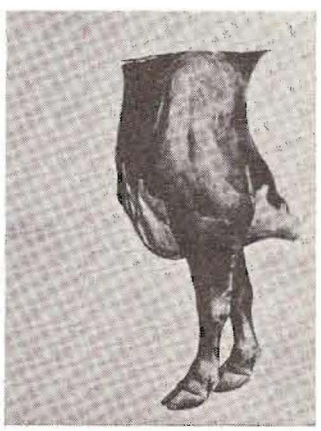
HIGH FERTILE

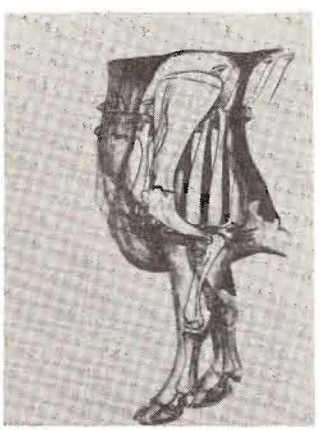


A scale drawing of a highly fertile Hereford cow. This cow is eight years old and has had seven good calves.



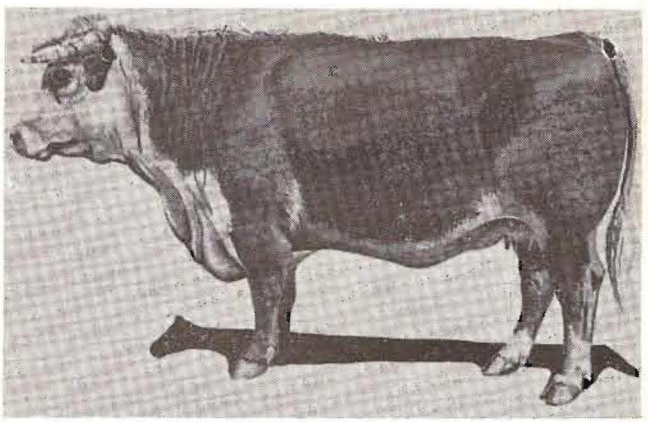
The head of a highly fertile cow that has had seven calves at the age of eight years. She has a calm, lean, matronly head, and the horns are of a uniform color, a desirable point.





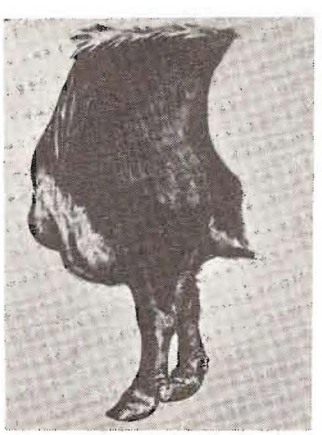
The forequarter of a highly fertile cow is shown in the above pictures. An X-ray drawing at right, above, reveals the relative placement of the bone structure compared with the sub-fertile pair of pictures seen to the right of the two above.

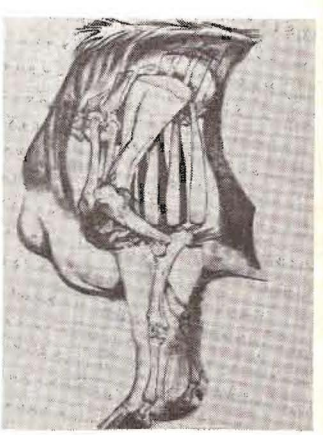
LOW FERTILE



This scale drawing shows a sub-fertile eight-year-old cow—half-sister to the highly fertile cow at left—which at eight years old has had three calves. Note the "steery" head and the coarse hair on the neck and shoulders and in the mid-rib flank region.

Note here the "steery" head of a sub-fertile cow and the coarse, bristly hair on the crest of the neck. It also is evident that the horns are not of a homogenous chemical composition. Note, too, the heavy cheeks and lower jaw, and the full, forward-pointing brisket.





The sub-fertile cow in these two illustrations shows the contrast of conformation with that of the fertile cow in the pair of pictures at left. Note how much heavier the forequarter is in the sub-fertile cow, and the difference in placement of the bones.

How to Select

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joint), is short in the sub-fertile animal. The skeletal development from the sixth vertebra forward is out-of-proportionally large and from the six rib posteriorly it is relatively small. The skeletal development of the highly fertile, functionally efficient animal is well balanced.

The silhouette shape or form of the sub-fertile animal resembles that of the undomesticated, relatively late-maturing antelopes, or even the buffalo or bison, the chest and thoracic region being deep and flat. The abdominal region and pelvic region are relatively small and cut in at the flank. That is one of the main reasons why I am opposed to stressing depth of chest too much in judging standards.

II. The hair and hide play a most important role in the welfare of the animal. In judging animals for functional efficiency, the condition of the hair and hide should be carefully scrutinized.

The hair and hide comprise the heaviest single organ of the animal's body and it fulfills many functions.

It is the organ which protects the complete internal structure of the animal against external environmental influences, physical injury, infection, etc.

It is also one of the organs which has a tremendous influence on the thermo-regulatory mechanism of the animal. It protects the animal against heat and cold and, hence, hair growth is seasonally controlled by changes in light intensity and duration, that is, the photoperiod (length of day and night-circadian rhythm).

Temperature also has a very marked influence on hair shedding. The difference between summer and winter daylight and the difference between summer and winter temperatures greatly influences the coat cover. In those areas where the daylight length between summer and winter is great and where the summer and winter temperatures vary greatly as, for instance, in the far north of the Northern hemisphere, we find the heaviest coats amongst animals, and the greatest difference in coat cover and weight during summer and winter.

The hair and hide are also an index of the animal's nutritional status. The poorly nourished animal usually has a dull, dry, often faded coat. The well-nourished animals have a bright, full lively and often waxy coat.

That the coat is greatly influenced by the hormones, especially the sex hormones, cannot be doubted anymore. If a bull is castrated the hair color and thickness (diameter of hair) changes within two to three months. In work carried out in the Department of Animal Science at the University of Pretoria it was shown that the bull's hair is thicker and darker (masculine hair) than that of steers.

Color slides of bulls and steers taken at regular intervals before and after castration, and thereafter at three monthly intervals, show that the bull's hair becomes darker and thicker than the steer's, which became lighter and finer.

In a series of other experiments it was shown that spayed heifers treated with female sex hormones (oestrogen) shed their hair beautifully and were sleek coated. Spayed heifers which were not treated were rough coated.

In work done in the photoperiod rooms at the University of Pretoria it was shown that the animals with rough coats had a much poorer gonadotrophin (sex-hormones) status than those with a smoother, more feminine coat.

The young heifer that has reached puberty and that comes in heat regularly develops a characteristic hair pattern.

The hair on the udder of the highly fertile cow that pro-

duces an abundance of milk is short while on the sub-fertile, poor-milk producer's udder it is very dense, furry and there is very long thin hair, especially around the teats. The teats are also very often anaemic, a pale and dead white, lifeless color.

The hair of the bull has the characteristic masculine pattern, heavy on the head, neck and upper shank region.

The brown hair on the Hereford bull has a characteristic darkening on the neck and chest, upper shank, lower ribs and lower thigh region. The hair above the tail brush or switch is often dark, occasionally almost black, so much so, that some breeders seriously discriminate against this. It is usually bulls that have tremendous libido that show these phenomena. If a bull with very dark hair in the tail above the brush is castrated the dark hair fades within a period of 2½ months.

Very dark hair in the tail above the switch is to be discriminated against in the case of cows because it is a masculine trait.

Masculine hair on the neck and on the crest of the neck in the cow is seriously discriminated against.

Every female has a fan-shaped crown of hair about halfway down the crest of the neck. The hair on top of the neck, from the poll of the head to this fan-shaped crown, grows flat in a posterior direction, while the hair from the crown in the center of the back to the crown on the crest of the neck grows flat in an anterior direction.

If the hair from the poll of the head to the crown on the back stands erect, bristly and is muddled so that it makes it almost impossible to determine in which direction the hair is growing from the poll of the head to the crown on the neck, and from the crown on the neck to the crown on the back, and the hair from the crown on the back to the tail setting on the rump which should grow to lie flat to the rear, is very muddled along the spine and along the sides of the belly region, it is almost certain that such an animal will be most difficult to get in-calf.

III. The distribution of the fat deposits, especially on the hip bones and pin bones is a sex-linked characteristic; it is a feminine trait.

Bulls very seldom have fat deposits on the hips and pin bones. The deposition of fat is not only an index of nutritional status, but is also influenced by hormonal function.

Cows that have an abnormal steroid metabolism often are sub-fertile.

The characteristic fat deposits of the sub-fertile cow are located as follows: on the cheek between the shoulder blades (a buffalo hump—Cushing syndrome); on the shoulder; an oval patch in the lower mid-rib region; a lump in the loin region; a solid, very often hardened, patch on the hip-bones; a soft patch on the pin bones; on the brisket; an oval patch about six inches long and two inches wide half-way between the external genitalia and the udder, and, lastly, a fairly large deposit of fat just in front of the udder.

Cattle that are over-fed to fit them for shows often are very fat in the flank region. Both bulls and cows are often flabby in this region.

These animals are often described as smoothly and deeply fleshed. Unfortunately, however, it is not smooth fleshing but an objectional layer of fat.

There can also be no doubt about it that the reproduction performance of over-fat heifers is impeded. The work done by L. A. Nelson and L. F. Miller, a summary of which was published in *The Cattleman,* Fort Worth, Tex., reports some very interesting information, as follows:

"There was about a 10 percent decrease in the number of animals that conceived at the first service in the high-energy group as compared to the normal group. The high-

level group required 1.54 services per conception, while the normal group required 1.25 services per conception. The number of services per conception for the second calving points out more dramatically the adverse effect of excess finish. Heifers reared on the high-level required 2.14 services compared to 1.41 for the normal group."

The points indicated by the accompanying Table II also are most revealing.

TABLE II.

Weight Performance and Productivity of Twin Heifers Through Their First Lactation

ENERGY LEVEL	*Normal*	*High*
AVERAGE WEIGHT–LBS.		
Beginning of trial	464	460
First mating	679	999
First calving	827	1,334
No. cows needing assistance at calving	1	6
No. calves lost at calving	1	3
No. cows lost from trial	0	2
Birth weight of calves, lbs.	60	64
Weaning weight of calves, lb. (210 days)	374	338
Average daily milk production, lb. (112) days	9.2	6.8

Bulls that are over-finished for shows often lack libido and as a result of this often produce disappointingly small calf crops.

The testicles of the over-fat bull often do not descend properly in the scrotum and are much wider at the base where they come through the inguinal canal than at the apex.

Bulls with testicles that are very wide and fat at the base in the inguinal region (groin) and which taper to a narrow point have poor thermoregulatory control of the testicles and produce abnormal sperm, especially tailless sperm. The testicles should descend properly in the scrotum, the scrotum should be widest over the mid-testicular region and should form the characteristic narrowing or bottle neck above the testicles and again a widening at the base where it passes through the inguinal canal.

The testicles of bulls that become over-fat after maturity descend or sag too far down and are prone to injury.

Injury to the vascular system of the testes will also interfere with the thermoregulatory mechanism of the testicles and will cause sub-fertility. This type of abnormality is often encountered in bulls of the British beef breeds when transferred to the tropics and sub-tropics.

It is my considered opinion that the steroids of the body-fat in the over-fat animal absorbs the steroids of the sex hormones and form these hardened lumps of fat found in the brisket, on the hips and loins of over-fat, sub-fertile cows.

One should guard against the over-fattening of young stock just prior to and immediately after puberty. I am strongly opposed to overfattening of livestock in any stage of their development.

IV. The muscular development of an animal is a sex-linked characteristic. The male animal develops clearly defined muscles, while the muscling of the female is smooth and not clearly defined.

The masculine bull has a clearly defined muscular crest on the neck while in the Bos-indicus breeds it is a clearly defined hump. The muscles of the neck are clearly defined.

The muscles of the upper shank are well developed and clearly defined. The muscles of the hind limb and thigh are also clearly defined. In the cow the muscles are smooth and not clearly defined.

In all the feeding trials where heifers, steers and bulls are fed, the bulls have by far the most prominent muscle development as measured by the area of the rib-eye muscle.

The really masculine, virile bull has prominent muscle development and does not give the appearance of smoothness. The muscles look as if chiseled out of wood or rock and are free from fat deposits.

The cow is smooth and the muscling is not prominent and clearly defined.

Cows that are masculine in appearance and that have clearly defined muscles often have small, smooth ovaries.

A cow can be well fleshed without having the prominent muscular display that males have, and that is what we want in the cow.

The cow with clearly defined muscles that is masculine in appearance usually has coarse hair and, if horned, heavy horns.

V. Animal behavior and temperament is the fifth and last chapter of the "living book."

The cow which is nervous often has thyroid disturbance (hyperthyroidism), is often difficult to get "in calf," and usually has poor mothering ability. These very nervous cows are usually poorly fleshed, and carry their heads very high.

Nervous cows have a poor temperament and make ranch management difficult. The lethargic, over-fat cow is often myxoedematous, is also difficult to get "in calf," and often cycles irregularly. The myxoedematous cow often has very prominent, bulging eyes, the sclera of the eye showing prominently white.

Bulls that are myxoedematous have large bulging eyes, lack libido and often produce abnormal sperm.

Bulls that are sexually active are alert, and are interested in what takes place in their surroundings. They very seldom look drowsy, with half-closed eyes.

The release of ovulatory hormone is stimulated via the central nervous system. It is on this concept that the use of vasectomized bulls is recommended in cow herds, especially heifer herds, a few weeks prior to the breeding season to stimulate ovulation synchronization in an effort to concentrate the calf crop over as short a period as is possible.

There can be no doubt about it that nervous impulses stimulate hormonal activity. For instance, goat ewes come in heat when they hear or smell a billy goat. The nervous impulse causes hormonal activity which causes a feed back to the central nervous system, and the characteristic courting and mating behavior results.

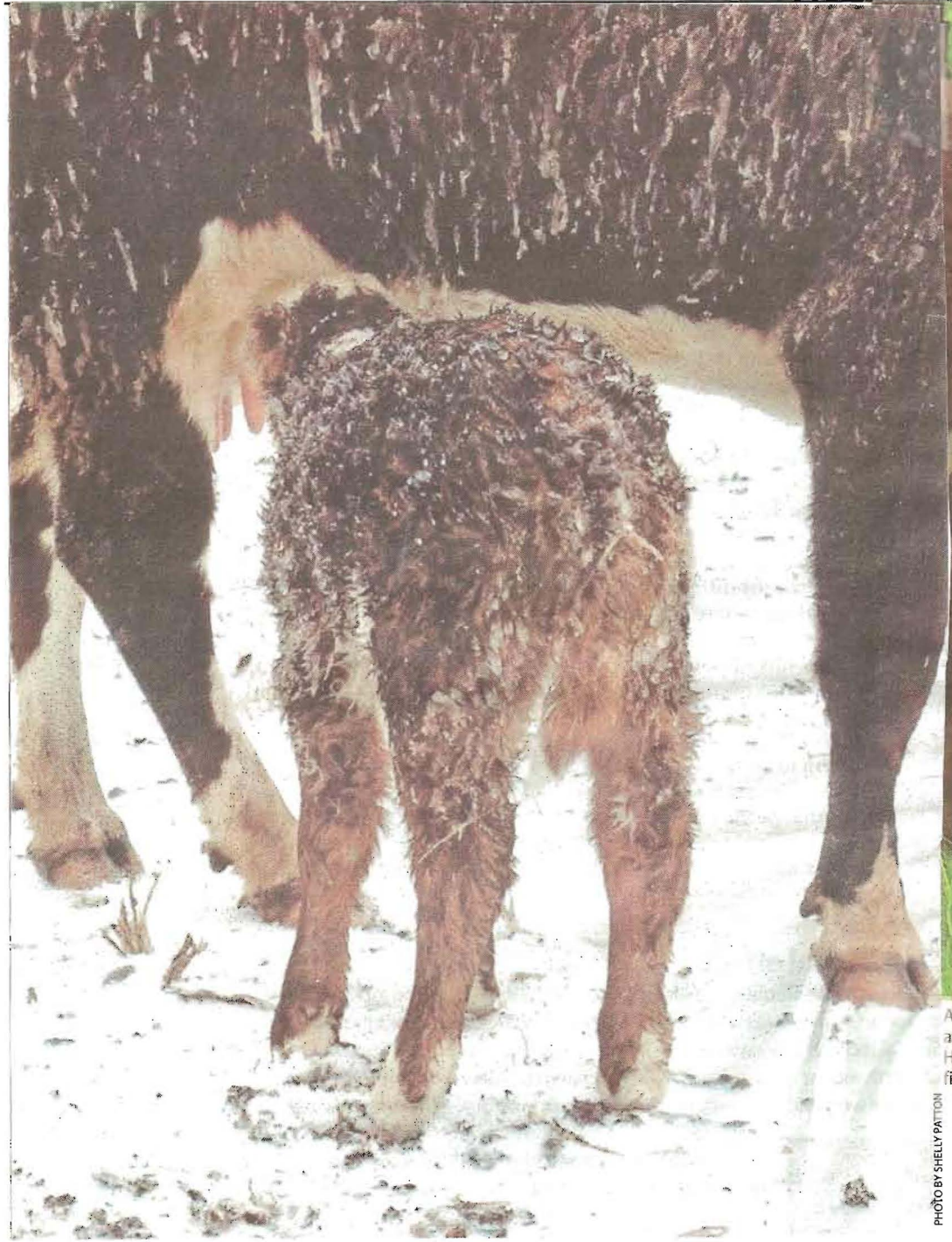
The whole object of judging livestock for functional efficiency is to get the livestock breeder vitally interested in his animals. He must observe his animals closely and interpret what he sees in terms of applied endocrinology and physiology.

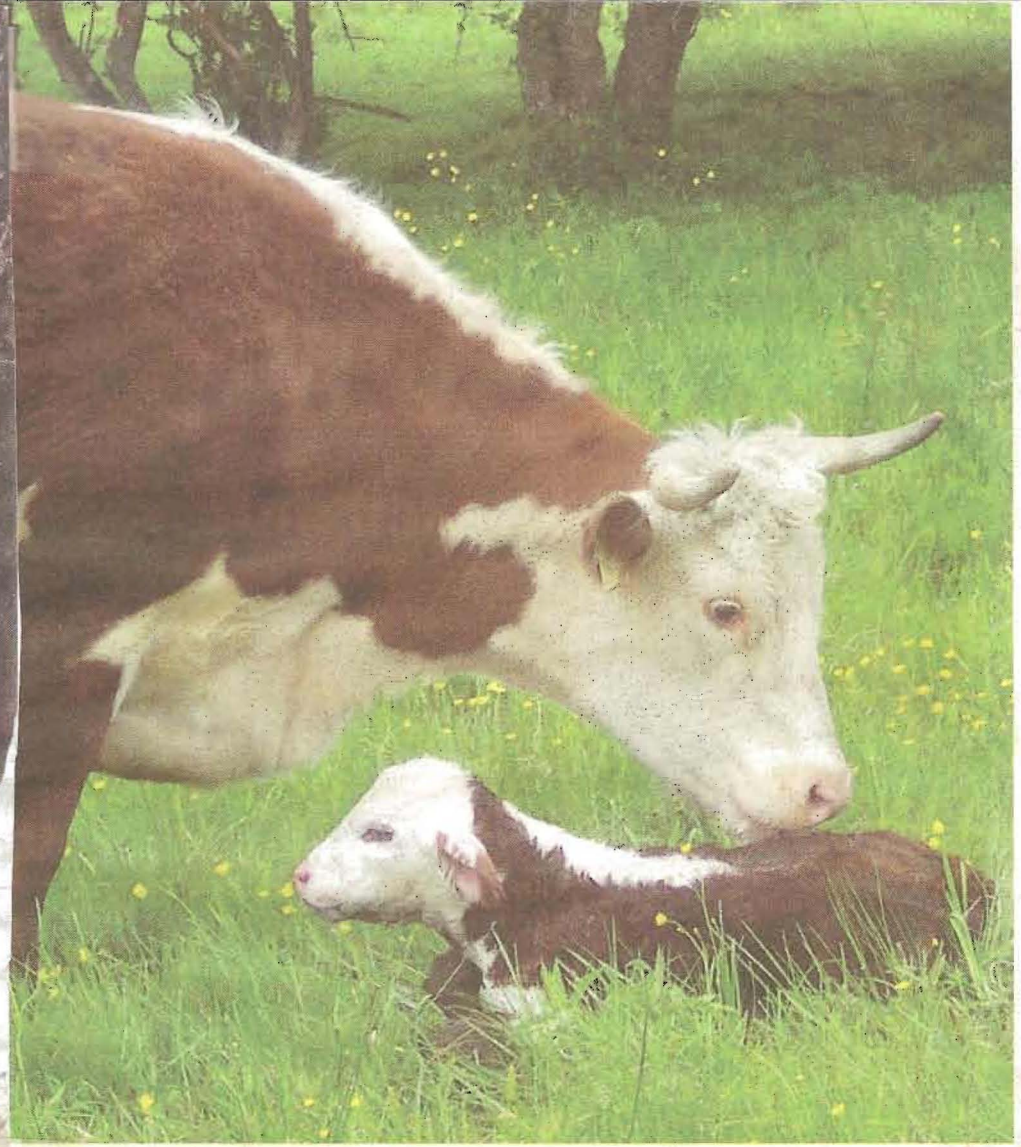
I am all in favor of performance testing plus visual appraisal. Many sub-fertile bulls with small testes (hypoplastic testes) have tremendous growth potential, and it is for this reason that I want to carefully inspect every bull or heifer from a functional efficiency point of view before subjecting them to a performance test. The concept of judging for functional efficiency must be another aid in making performance testing more efficient.

We cannot breed livestock with computers alone. They can help us locate the outstanding performers but they cannot subject the animal to an objective visual appraisal.

Man has not become a robot yet, and until such time computers should be used to assist us in interpreting data. But man must do the final judging and selection. Which reminds me of an appropriate quotation attributed to Ninon de l'Enclos:

"That which is striking and beautiful is not always good; but that which is good is always beautiful." □





After an unusually mild early winter in the Northeast, the temperatures from January to April were much colder than average and larger birth weights were observed in many cows calving during April and May. One Northeastern Hereford breeder's cows, including the female pictured, had an average birth weight 4 lb. higher than the previous five-year average. However, no increase in dystocia was noted and calf survival rate remained unchanged.

PHOTO BY SHELLY PATTON