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Breaks, Good and Bad: The Inner Life of Research

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is an acute, non-contiguous condition of young pigs that is often fatal. With the great increase in the pig population, with its accompanying overcrowding and the rushing of pigs through to slaughter weights as early as possible, this condition has once more come into prominence and in a more severe form than was the case years ago.

The etiology of edema disease is believed to be due to endotoxins produced by hemolytic \textit{E. coli}. The disease is most common in young pigs in the 8 to 12 weeks age group. Most often it is seen shortly after weaning, however it can occur in very young pigs and also in older swine up to market weight.

Predisposing factors seem to direct toward nutrition and stress. Usually the fastest-growing, thrifty pigs are affected the most, being on a good plane of nutrition. Stresses which may predispose are weaning, recent transportation, change from starter ration to a grower, and recent vaccinations.

**Clinical Findings**

1) Often find some pigs dead with no clinical signs
2) Incoordination of the hind limbs—swaying often from side to side
3) An attack of diarrhea may be seen in some of the pigs often before clinical signs of edema disease
4) Pigs are usually aware of their surroundings
5) Convulsions, which usually are not intermittent in nature
6) Edema of eyelids and conjunctiva
7) The most thrifty pigs are usually affected

**Post-Mortem Lesions**

1) Edema of eyelids
2) Edema in the wall of the stomach
3) Ansa spiralis of the colon is often quite edematous in pigs that have died of edema disease
4) Often very few post-mortem lesions are seen

**REFERENCES**


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**Breaks, Good and Bad:**

**The Inner Life of Research**

D. Dale Gillette*

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Once in a while, if you are lucky, you will get to read a technical research article which has some soul. The rest are corpses. Corpses are fine for their purpose, but they never reveal the inner life, the dynamic mechanism. An outstanding exception is the recent best seller in science, \textit{The Double Helix}; which details the very human development of a very important theoretical model (7). My own experience has nothing so singularly grand to offer, but throughout my work there has occurred a string of breaks, both good and bad, which seems to comprise a certain essence of research. Rather than making an organized scholarly report, I will try to tell it like it happened.

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I had just finished my first attempt on my Ph.D. dissertation "Observations on Uterine Contractions and Associated Phenomena in Cows at Parturition"—all 18 pages of it. I had worked furiously on it for 2½ days and figured it was done. My major professor reviewed it, called me in to his office, and told me it would just never do. When I pressed him for reasons, it came out that the material was fine, the results decent, but it was not long enough and that I would have to put in some filler. Filler? Are doctoral theses to be given on the basis of filler? I stormed out of there and went home. Filler! Nobody was going to make me put in filler. But what could I do? I wanted to graduate. Still seething, I dragged out the data, with vague hopes of finding something else that might be elaborated upon, to meet this demand and satisfy my own conscience.

I really do not know how it happened, but all of a sudden certain characteristics of the data (which had been there all the time) came to life; I became aware of data relationships and theoretical considerations chasing after each other. When the mental turmoil cleared, I had a new insight. I wrote it up. It filled many pages, and to date I consider it the most important part of my graduate research (2). Moreover, my major professor actually congratulated me. A good break.

Early in my postgraduate career, I became obsessed with the idea that adrenal steroids were very important in the birth process. I was convinced that parturition, in animals with a comparatively long gestation period, was controlled by adrenal steroids. So, I started working with guinea pigs (gestation of 68 days). I was doing laparotomies on near term pregnant females in order either to inject the fetuses with hydrocortisone, progesterone, or an adrenal steroid inhibitor or to remove one or more of the fetuses leaving the placentas intact. Most of the guinea pigs (dams) aborted, some died. I changed technique. Same result. I had others more proficient in surgery try it. No luck. Then, I did mock operations, just the laparotomy without opening and manipulating the uterus and fetuses. Same thing. I gave it up. It was a bad break.

Five years later, attending a conference, I learned about the exceedingly high, practically pharmacologic, natural blood levels of adrenal steroids attained during certain stresses. Shortly thereafter, Dr. William Adams published on his success in inducing parturition in near term cows by intramuscular injections of dexamethasone (7). Then and only then did I realize what was happening with those guinea pigs. That failure could have been a good break (5 years lead) if only I had had a bit of magic, insight, or perhaps (but I doubt it) perseverance.

Along the same trend, I became convinced that the role of adrenal steroids was not limited to initiation of parturition, but had other important functions near the time of birth. Mylon Filkins and I had translated this notion into an investigation of the effects of adrenal steroids upon the postnatal oral absorption of immune bodies by puppies (3). We were removing puppies at term by Caesarean section, injecting them intramuscularly with the test material and then waiting 4 to 24 hours before feeding homologous immune serum. Subsequent, titered agglutination reactions of the puppies' serum allowed us to evaluate the absorption. Our approach gave no change over the normal pattern of absorption. We tried injecting the puppies in utero one to several days before they were removed. No results. During this research we were drying up our source of pregnant bitches, and, when one of our suppliers called and told us he had a bitch that was about to whelp, but thought it might hold off a day or so, we bought her, hauled her in and immediately worked on her. Mylon reported that all of her puppies had decreased antibody absorption. Good break. Subsequent experimentation revealed that when the bitch was injected with either ACTH or hydrocortisone just before whelping, the pups would have decreased absorption of the antibody.

It is difficult to recall how it all started, but some years ago I was transplanting the ends of one ureter from the bladders to the rumens of sheep in order to see if the animals would need less protein.
Eating a ration which I considered as low in protein (9%), the sheep did not show this desired effect. Not only that, but the ureters were becoming plugged, and the associated kidneys were being damaged from either or both hydrostatic pressure and infection. Very discouraging. Because I had some goats available, the experiment was repeated with a very low protein diet, and the results showed not only a significantly better nitrogen balance, but also increased the total digestible nutrient of the diet (4). Good luck?

In the fall of 1968, I was on a faculty improvement leave and worked on para-biotic hemodialysis at Salt Lake City, Utah, in cooperation with Dr. James Preston of the V. A. Hospital and Dr. Willem Kolff of the Medical College, University of Utah. We decided to dialyze two dogs against each other. The blood from each dog was run on opposite sides of a semi-permeable membrane of an artificial kidney. The liver of one dog was damaged, and the idea was to see if the normal parabiologic partner could sustain the injured dog via an exchange through the semi-permeable membrane. We did not have much success. This and that went wrong, and most importantly, the normal dogs (and to a lesser extent the injured dogs) developed a disease syndrome, catarrhal enteritis, leading within 3 hours to hemorrhagic enteritis and heart failure. We tried many remedies: plasma extenders, local and epidural anesthesia, regional heparinization of the blood, and sodium bicarbonate (low CO₂ also developed). Twenty-four dog pairs were used, but we failed to demonstrate anything about the possibilities of parabiologic support. Bad break? One would think so, but I tend to doubt it. We will wait and see, and try to figure it out.

For the last 3 years, Dr. Rodney Ingraham and I have been trying to detail out the effects of weather upon the milk production and conception rate of dairy cows. We have had some success. In fact, we have just submitted several articles for publication (5, 6, 7), but, since an analysis of variance which divided the basic data into 225 subdivisions (9 basic weather classes, 5 divisions of the lactation cycle, and 5 categories of individual productive potential) accounted for only 56% of the total variability, I was rather unsatisfied and was trying to find better ways to locate and assign this variation. I had worked out a scheme by which each cow’s monthly milk tests would be compared to the average milk production of all the cows on the same day with regard to freshening. The day by day average milk production curve starting at freshening was being calculated with the aid of a computer program which I wrote for this specific purpose. The data of more than 500 cows for a 2½ years span was included, but I kept getting results which went up and down unaccountably. So, I checked my program, found minor mistakes, and continued. Still bad. I rewrote the whole thing. Still bad, but this time I decided my method was right. I plotted out the data and found 2 separate, superimposed, periodic curves which repeated every 22 days. The estrus cycle? Never been reported as so affecting milk production. Lucky break! Maybe. But this is the inner life of research.

REFERENCES

5. Gillette, D. Dale and Ingraham, R. H. Computational methods using herd records to evaluate weather influence on milk production (submitted to J. Dairy Science).