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Part K. Health and Nutrition of Breeding Pairs (Panel 3)

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INTRODUCTION–NUTRITION

HALLIWELL. I think nutrition is well exemplified by a little joke I heard a while back. It is a story about a farmer. One of his banker friends said, "Farmer Jones, why don't you go back to school and learn more about farming and then you could come back and do a better job of farming and have better crops and increased productivity." And Farmer Jones said, "Shucks, Banker, that won't do any good, I don't farm as well as I know how to now!" I think the same thing applies to those of us trying to breed birds of prey, and I speak in particular reference to the nutrition of birds of prey. What I have tried to do today is to go through some of the scientific basis of fact for the nutrition of birds of prey.

Pure and simple, nutrition is the transformation of food into living tissue, but this takes a lot of things from the time you lay it out to the bird until the time the bird transforms it into living tissue. In order for a diet to be adequate, it must first provide food for sufficient energy. Second, it must contain all the essential nutrients in correct quantities. Thirdly, it must be digestible and have a high biological value. By biological value we mean how many nutrients it has–vitamins, minerals, carbohydrates, proteins, fats. All essential nutrients must be

CARLSON. No. What you are doing by the high protein diet is increasing the number of B-complex vitamin requirements. But if they are satisfied it should not really hurt the animals. Protein is just as good a source of energy as starch.

HUNTER. I mean during the reproductive stage . . .

CARLSON. I suspect the first thing you might notice is smaller egg size if energy is really markedly deficient. I think if they had plenty of protein they would still be able to concentrate it.

GRIER. I don't remember the trace experiment. There was a man who studied rickets, and there were two groups one of which was fed chopped up feathers from chickens that had been irradiated and got rid of their rickets. The other group had not been irradiated and did not lose their rickets. So I think there is some possible Vitamin D synthesis going on here.

TEMPLE. One thing you have to be aware of, you are talking about a bird where this ultra-violet light is not reaching the skin. A bird has very little exposed skin—the synthesis is taking place apparently in birds on the feathers themselves not reaching the skin. There is no way that ultra-violet light could reach the bulk of the skin on birds. It reaches of course on the face and beak.

WHITE. In birds it is hypothesized that the reason for preening is to take oil out from the uropygeal gland, put it on the feather, and then as they repreen, the oil on the feather is irradiated and as they repreen they then take this back into their mouth.

GRIER. I think that whole thing has been pretty well discounted. For example, the experiments were repeated but without success, and there have been recent literature and reviews pretty well discounting the whole thing; it seems they do get enough radiation through the feet and lores and ceres.

TEMPLE. What he did when he discounted was to say that probably the irradiation of oil on the feathers into Vitamin D is minimal compared to the dietary sources. The primary sources of Vitamin D are dietary, coming from whatever the bird is feeding on.

HALLIWELL. The relationship of ultraviolet light and Vitamin D_3 or usable metabolically active Vitamin D and the absorption of calcium from the gastrointestinal tract was brought up and I wonder if you would speak in the general area of Vitamin D production in birds as well as the utilization of Vitamin D.

CARLSON. If birds are exposed to about 15 minutes of sunlight a day the kind of sunlight we have most of the time in South Dakota you shoudn't have to worry about Vitamin D. Of course this isn't always the case and when you

that egg, the eggshell must sustain life of the embryo through hatching. Maybe that's the reason we are getting some of the early embryonic death; that is what I am really trying to say. I went through the literature for 1969, 1970, and 1971 over the past months and I have tried to pull out facts from the literature pertaining to early embryonic death as well as to the adult male and the adult female.

I would just like to list these specific entities that were directly related to health and nutrition of adult birds that would be interesting to you, such as *Vitamin A.* In studies with poultry when you decrease the amount of Vitamin A, you decrease fertility of males, decrease fertility of females, get embryonic death at two days after laying the egg. The young embryo metabolizes almost all of the Vitamin A in the period of time from the laying of the egg until that embryo pops out of the egg. And this is one of my reasons for being somewhat reluctant to suggest or even condone the feeding of day-old chicks. I think Dr. McIntyre has corrected this situation himself very excellently and I really think I agree with him as far as ease to the individual falconer. You can buy the baby chick locally or even buy them from Sears and Roebuck for a very reasonable fee, put them in a brooder, grow them to young adulthood about four to six weeks of age. Feed them on a good quality starter feed and follow the recommendations. Feed their best feed, take good care of these chicks until they are four to six weeks of age; at that age take them out of their brooder, wring their necks, put them in a baggie and put them in your freezer. Don't gut them, don't pull the feathers off them, cut the feet off them, leave the head on and put them in your freezer. As you need, pull them out and feed your birds. What are you doing here? First thing, trichomoniasis, what we call frounce and the pigeon fancier calls canker, will not exist after 18 hours of freezing so you can take the most trichomonad infected pigeon, freeze it for 18 hours and you can feed it to my birds.

The next thing I want to discuss is *Vitamin C.* You are all familiar with Vitamin C or ascorbic acid—it's been known since the day of the limeys. Low quality, low amounts of Vitamin C in the diet are reflected in poor albumen quality meaning low protein for the albumin of the egg. Now I don't know whether this has any effect at all on the livability of the young chick that's developing in the egg but it seems to us that if the protein quality is down, the chick has less chance of survival. So I'm just mentioning it for what it's worth.

Vitamin D can be fed as an inactive form which can be activated by the action of ultra-violet light with the skin. But you can also feed the active form. So I think you ought to make amends one way or the other to have vitamin D in this bird. Vitamin D is absolutely necessary for calcium absorption by the intestinal tract. You can feed a bird pure calcium phosphate rock and if he doesn't have enough Vitamin D, he won't absorb any of it, it comes out the other end the same kind of rock. The lack of Vitamin D inhibits egg production which again is tied up with the calcium.

Choline, methionine, and Vitamin B_{12}, high levels of these nutrients, increase egg production and increase egg size in birds. *Vitamin E* is involved in feather

coat; it's involved in ovarian and testicular function. It seems to have a very good ameliorative effect on stress, meaning if these birds go into a captive situation after being trapped, perhaps they are utilizing Vitamin E at a faster rate and an adequate supply of it may help us acclimate these birds to captivity.

Calcium I have already alluded to, but to stress it further, normal laying hens when put on a deficient diet, reduced their laying ability by more than 50% within a week or ten days and that's a pretty significant thing to consider.

Diethyl stilbestrol and *methyl testosterone* seem to have a relationship to egg production and fertility.

Phosphorus and calcium go together. They have to be present in sufficient quantities, they have to be present in the correct ratio, and they have to have Vitamin D for this. *Sodium* is also required in the diet. *Selenium* seems to be important in raising young chickens; on a selenium deficient diet they got poor growth in young chicks. *Manganese* is another mineral; it again is tied in with the calcium and phosphorus ratio. *Magnesium* is the same type of thing.

Protein. Poultry grow best on a ratio of approximately 20% protein. This can be lowered with commercial poultry. However, they find that for unadulterated protein, you need about 18 to 20% for the chickens to maintain good growth rate or good egg laying rate.

SWARTZ. Arginine as well as methionine are I believe essential amino acids in birds. They are also important structural components in feathers and hair. At least it occurred to me as a possibility that maybe here when the ingestion of feathers might have some meaning in terms of a specific nutrient.

HALLIWELL. To further elucidate that, methionine is the first limiting amino acid in protein synthesis, meaning when you have decreased protein synthesis it is probably due to a deficiency of methionine. Now I am not willing to express myself on whether all parts of the body contain methionine and other amino acids, but you are correct in that feathers do have quite a bit of methionine.

VITAMINS

CAMPBELL. Why do you add Vitamin A and carotene to the diet?

HALLIWELL. I frankly don't know why they added both. Carotene is a precursor of Vitamin A, meaning that carotene is converted into Vitamin A. It may also go into some other enzymatic reactions and just about every reaction in the body is controlled by enzymes–it may fit in there or some other reason unknown to me.

HUNTER. Do you think there would be any chance of getting into difficulty when there is an imbalance between protein and energy, in other words you have very high protein and low net energy?

CARLSON. No. What you are doing by the high protein diet is increasing the number of B-complex vitamin requirements. But if they are satisfied it should not really hurt the animals. Protein is just as good a source of energy as starch.

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are in captivity you do have to supply it in the diet. As you mentioned there are Vitamin D's. Any of the Vitamin D's that are used for most of our large animals are not potent for birds. Birds must have Vitamin D_3 or calciferol and we find just recently that this is modified by the animal. And even a more potent form could be used, but calciferol or Vitamin D_3 certainly at the present time is the most acceptable type.

TEMPLE. I talked with the nutrition people at Cornell and asked them about the calcium-phosphorus-Vitamin D complex. They came up with a very simple dietary supplement that answers a lot of the problems. That is powdered nonfat dry milk. That milk product has a very high and a very well-balanced calcium-phosphorus ratio. Perfect for birds of prey, in fact. It also has calciferol in it.

CARLSON. Well, I wouldn't expect it to have very much. I would certainly not rely on milk as a source of Vitamin D. But as far as calcium-phosphorus, you can't beat milk.

THOMAS. The person that wants to use supplements would like to know what is the best supplement to get your D_3 from and what do you have to have to make it available to the bird? I wonder what I need to look for as far as carotene. If I get Vitamin A in liquid form, is it available to the bird biologically once it gets in the system? You can get pellets or tablets, whatever, it's got A and D, but if it doesn't say is it D_2? Is it D_3? The only thing that I've been able to find is a stuff called Linotone, it's a coat conditioner for dogs, and it's very high in Vitamin A and D_3, it's got a lot of it in it, and I give the birds a half a teaspoon split between them every day but I don't know whether the D_3 in this is biologically available to the bird. I suppose if we could know more about supplements, as to availability this might be one more practical solution that we could use.

GALICZ. What may be a source of Vitamin D, artificially or supplementary?

CARLSON. Well, we buy it in ton lots as irradiated calciferol. We have any number of vitamin supplements that are used in poultry feeds that you can buy at your veterinary supply house that have potent Vitamin D.

VOICE. What about what you can pick up at a drug store that has the cod liver extract type of thing?

CARLSON. That would be fine.

VOICE. Does it have calciferol?

CARLSON. It has calciferol. You want to stay away from irradiated yeast

and irradiated vegetable products. That is Vitamin D_2.

HALLIWELL. This brings another question to mind again. People are supplementing their diets with additive vitamins. I have my own opinion but I would like yours on the danger of hyper-vitaminosis or hyper-nutritionalism due to if one drop is good five drops is five times as good, a type of syndrome which we all fall prey to.

CARLSON. Well, of course, of most of the commercial feeds we see we don't see a stated potency as far as vitamin activities are concerned. For example, if we were thinking about Vitamin D in terms of the laying hen about 100 international units per day should be plenty adequate. We could go as high as, however, let's see it's about a factor of 20, in other words up to about 2000 international units and still not be toxic to the bird. You can't do that with some of the others, however. Vitamin A will cause you difficulty rather quickly if you get above about 25-50,000 international units per day. So again I would like to temper that by saying it depends on the type of multiple excesses that you might give the bird. Chances are that you could go to three or four times the recommendation and still not hurt the bird or its reproductive potential because there is quite a wide range between requirements and toxicity as far as most of the organic vitamins. The same thing cannot be said for the minerals. You can certainly put in an excess of minerals very rapidly. This should be of greater concern as far as I'm concerned.

HUNTER. In ruminants it is very important for the utilization of Vitamin A to have Vitamin E. Now are you suggesting that in these frozen chick diets, we might supplement with Vitamin E? And D?

HALLIWELL. I Frankly don't think so. Now this is my own personal opinion. Vitamins A, D, E, and K are all fat soluble vitamins, that is they exist in the subcutaneous, the abdominal, the heart fat and unless some oxidant has gotten into this chicken, such as long freezer storage, there should be sufficient amount of these vitamins in the fat on, again over four week chicks.

CARLSON. As far as Vitamin E and Vitamin A interactions are concerned, basically it is Vitamin A that the bird is really needing and Vitamin E is sort of an antioxidant that protects Vitamin A; at least that's the latest. We have had a lot of go arounds as far as Vitamin E as to whether it is really essential or not. About 15 years ago some work came out showing that it was not essential. Then five years later some people reported that it was essential and so on. But at the present time it is thought that selenium, one of the minerals, apparently produces or carries on all of the activity normally we thought Vitamin E was doing. If we have an adequate amount of selenium available for the animal we can very definitely show that the Vitamin E requirement is greatly reduced. So that basically the large amounts of Vitamin E that we usually put into animal feeds is

there to protect the Vitamin A to a large extent. Well that means of course we could use other things besides Vitamin E. We could use any one of a number of commercial anti-oxidants that are available today.

HALLIWELL. Many of the birds that we have in captivity today are over five years of age and they may or may not have been at some time during the first years on a deficient diet. Could you discuss the effect on the reproductive organs of previous nutritional deficiencies. In other words, the bird that is metabolically nutritionally deficient two years ago and on adequate diet today, would you expect damage to the reproductive organs of a bird today? Or do you assume that they will rejuvenate?

CARLSON. It depends only on the deficiency that you encounter. As far as Vitamin E deficiency is concerned, and again it depends on the extent of the deficiency, if it were an extreme deficiency, of course, it is irreversible. It wouldn't do any good to try to correct a bird that had been so handled. But I don't suppose that they would have survived either. Generally speaking I would say unless it is one of these more critical nutrients, if it's just a marginal deficiency, I believe when you get a bird back on a normal diet that their reproductive capacity would recover as well.

HUNTER. It seems to me that there is an area here that we need to hit quickly and this is supplementation of vitamins to whatever diet we are using. Can you go wrong in having too much vitamins?

HALLIWELL. Yes, you can have hypervitaminosis.

MINERALS AND WATER

HALLIWELL. For minerals to be utilized by the body they have to be there in sufficient amounts and there are interrelationships between them, they have to be in some particular form so they can be absorbed. For instance, fats will combine with calcium and form an insoluble soap that is unable to be absorbed by the intestinal tract, as a matter of fact. If you put calcium in high quantity, it seems to be absorbed by the intestinal tract by diffusion, in other words there is no metabolic expenditure of energy, cellular energy to absorb this calcium, but under situations of low calcium intake there is an active expenditure of energy by these cells to absorb the calcium that is present within the gastrointestinal tract and take it into the body. So this whole thing is wrapped up again and you can't talk about one individual mineral as a point.

TEMPLE. An interesting case with calcium would be the female Red-tail that I used in the insemination work. She was obtained from a very naive farm boy in Iowa who had had the bird for nine years as a pet. He was not a falconer, just kept her as a pet; for nine years the bird never received casting. She received

nothing but beef heart and beef liver as the staple diet. That as we know is about the worst food you could put into a bird. When we got her at Cornell we only had her for about one month before she entered a reproductive cycle for us and she laid one egg normally. The next egg was laid without a shell. She went into a hypocalcemic condition similar to what poultry people call egg layer's cramp from chickens laying too many eggs and getting rid of too much calcium in it. What this bird did was wipe out her calcium reserve with one egg and the second egg was laid without a shell. In this case we administered calcium gluconate in the diet in large quantities and the third egg came normally and was fertile. As I say there is a good chance that early abuse in terms of a bad diet something like this is easily remedied.

CARLSON. Especially in terms of calcium, if you give them too much calcium during their growing period this can be very serious.

PLATT. You have mentioned the problem of calcium with young birds exposed to overdosage. What's that?

CARLSON. The bird gets used to excess amounts of calcium and basically the kidneys are just overworking and you end up with just an overloaded kidney. It is not going to be able to metabolize calcium later. There is a lot of necrosis as the veterinarians refer to it and gout and things of that nature that the bird would eventually succumb to. What we would like to do of course as soon as the bird is about ready to come into production, precede that for about a week or so with a diet that does have in the neighborhood of, for your type bird I would suppose about 2% calcium rather than the usual .8% that you are routinely feeding during the growing period.

Someone asked the question and I will repeat it for him. In terms of what could be deficient as far as a diet of meat or basically animal food is concerned? First as a poultry nutritionalist my experience is largely in the area of that type of an animal where they eat mostly grain or other byproducts of the vegetable kingdom and very little animal food. In fact today we probably have no food of animal origin in most of our poultry diet. But as far as meat protein is concerned there is one mineral that could perhaps be deficient and that is zinc. Normally when we feed high meat diets to poultry one of the things we look out about or worry about is the possibility of deficiency of zinc and this could be a factor of course, particularly in reproduction, in that it is required for sexual maturity, precocity and so on. So this is perhaps something that some of you might want to give some thought to. The natural diet where they get mostly meat just isn't going to carry a whole lot of this mineral for the animal. You may have to supplement with a supplement commercial type feed.

CRAWFORD. Is a deficiency of manganese important?

CARLSON. This is true if manganese or some of these trace minerals were in

the diet at rather marginal levels. You can increase the requirements for almost any of them by going excessive in terms of calcium-phosphorus ratio. If you have a good supply of manganese, zinc, and other trace minerals then you can vary your calcium levels quite widely without any great detriment. That is how we first discovered the importance of manganese. We put in extra calcium and phosphorus and sure enough the birds came down with sclerosis. When we put in 30 ppm of manganese, we don't have to worry about it.

CRAWFORD. What supplemental dose of manganese is used?

CARLSON. In the poultry case you put in a half ounce of manganese sulfate per ton of feed, 30 parts per million. Use a trace mineral salt that contains well about 1% manganese.

MARCUS. Did I hear you say you found that zinc was important for the reproductive process?

CARLSON. Yes. It's one of the more recent findings as far as mineral nutrition is concerned.

MARCUS. Where exactly is that concentrated?

CARLSON. In the ovary. The size of the yolk is greatly reduced in the case of a zinc deficiency. In fact if the animal is very markedly deficient you don't get any reproductive activity at all, even the sexual characteristics.

MARCUS. What I'm trying to find out is, what is a natural source of zinc for a raptor, a logical natural source for a natural supplement.

CARLSON. That's a real good question. Meat is very poor. Bone meal might have some. But zinc oxide, zinc sulfate, zinc salts of various sorts could be incorporated into a trace mineral mix to provide you with enough.

OLENDORFF. Does anybody have any ideas about egg binding, egg boundness in females. I understand this has been a problem.

HALLIWELL. Dr. McIntyre, has anybody ever called you about egg bound birds?

McINTYRE. No.

HALLIWELL. Has anybody else experienced this? Frankly, I don't feel the expert either; as far as I know it is inability to lay the egg. The ovum is released from the ovary, the white is secreted, the shell is formed, but the egg is not laid and that is as much as I know about it. I've never been consulted about the

malady.

WOLHUTER. Some of the literature of European zoos that are raising birds mentioned that birds that breed early in the season during cold temperature are more frequently egg bound, but whether it is indeed a function of temperature, I don't think has been proven, but this is one possibility.

LAWSON. Some work done in poultry indicates that it might also be due to water deprivation. You have to give adequate quantities of water.

HALLIWELL. Which would tie in with frozen water pans.

TEMPLE. I would like to make another point more closely related to breeding and water intake. I think anyone that has had any egg laying females has noted, and it is well-documented in poultry, that water intake goes up tremendously during egg production, because the bird is mobilizing a lot of water to go into the egg. It is very important that the bird has easy access to a lot of water when breeding.

COMMERCIAL BIRD-OF-PREY DIET

HALLIWELL. To my knowledge at the present time there are two commercially produced bird of prey diets and I am quite familiar with one of them. It is a product called Zu-Preem put out by Hill's Packing Company (Table 1). I don't get any commission, I am not peddling it. I'm just trying to use it as a

Table 1. Manufacturer's ingredient list and guaranteed analysis of Zu/Preem Bird of Prey Diet (Hill's Division Riviana Foods Inc., P.O. Box 148, Topeka, Kansas 66101).

Ingredients: Horse meat, horse meat byproducts, meat byproducts, chicken, fresh liver, ground corn, ground wheat, fish meal, dried whole egg, dicalcium phosphate, brewers dried yeast, iodized salt, choline chloride, Vitamin A palmitate, carotene, D-activated animal sterol, a-tocopherol, menadione, niacin, calcium pantothenate, thiamine, riboflavin, pyridoxine hydrochloride, folic acid, biotin, Vitamin B-12 supplement, ferrous carbonate, manganous oxide, zinc oxide, copper oxide, cobalt carbonate, magnesium oxide.

Guaranteed Analysis

Crude protein	min.	18.0%	Ash	max.	4.0%
Crude fat	min.	5.0%	Calcium	min.	0.4%
Crude fiber	max.	0.5%		max.	0.8%
Dry matter	min.	40.0%	Phosphorus	min.	0.3%
Moisture	max.	60.0%			

good example where we are falling down. The bird of prey diet put out by Hill's Packing Company has about 60% moisture which comes up again to the general area of 70% of body weight being water; protein, it's up about where the National Research Council recommends, 20%; fat, it has an adequate quantity; ash, remember in muscle meat ash is way down around 1%–here it is 4%. Vitamins–they do exist in specific quantities in this bird of prey diet and this is calculated with each batch that they mix up. And so we do have some idea what we are feeding the birds with this diet. Dave, would you like to talk about your programs at the Kansas City Zoo and any recommendations you have?

ALLEN. We have a pair of White-tailed Sea Eagles that have been on this diet for 23 months and they have reared progeny in 1970 and 1971. I would like to show you some pictures and add a few comments to what Dr. Halliwell said. This is the exhibit of the Kansas City Zoo where the pair of Sea Eagles is exhibited. This was an old mammal enclosure that was built by WPA in 1940 and these birds came to the zoo in 1964. We covered the bars with wire and the top with chain link. That is the pair on the nest. Now there are two nest frames and I turned in a breeding project questionnaire and there is a diagram in that BPIE No. 69 (*Raptor Research* 4(2):23-25, 1970). The birds chose the front nest which I believe is 15 or 18 feet from the public. And that is where they have nested and raised their two offspring. Here's a picture of the nest frame from the access door. The bottom is about six feet tall and the dimensions are in the BPIE. Both the 1970 female and 1971 male offspring were much larger than either of the parents and I think this is probably due to fat, lack of exercise, and I hope, superior diet; it worked very well. Now the back nest frame against the wall is the one they used mostly for perching. They can get back on the back edge under that ledge for shelter from the rain, sun, snow, it's the only protection they have.

The diet comes frozen, a five pound package, eight packages to the case. We feed two portions. A Kestrel portion is about the size of a ball we form and a larger portion for Golden Eagle. I did not know about the Nebraska product until today. I had heard they were working on it, but didn't know they had it out. The price is $12.85 per case and eight five-pound frozen chunks. Now a few falconers in the Kansas City area had a little difficulty in getting this product, but what we do is buy it in carload lots, store it in commercial cold storage and draw it off. Others can draw off it too, and they are charged for it. But this would have to be worked out with whoever uses Zu-Preem. You have to have a place to store it and freight on it will be quite expensive. I think you have to buy 40,000 pounds before they pay the freight. Birds have been on it for 23 months and they have produced two very large and healthy offspring. I would like to add that the manufacturer states that the pesticides DDT, DDD, and DDE are controlled during processing to .088 parts per million. Now I don't have any comparison figures today on what food of chickens, fish, horsemeat contain, but I know this will be considerably lower.

HALLIWELL. DDT in regular dog food and other meat byproducts varies, this ranges somewhere around 20 and 30 parts per million, so you can see that this is one-tenth.

ALLEN. Now the way it was explained to me is that they use a fish meal, human grade fish meal, and they have developed a process to remove these residues to this level, which I thought was significant considering we are talking about White-tailed Sea Eagles; their previous diet was fish, prepared fish.

To give you an example of what Dr. Halliwell mentioned, in mackerel, which was one of their favorites, the calcium to phosphorus ratio was 1 to 34. They were also fed smelt. We had a big problem with smelt to do with sea lions; now this is not other fish eating raptors, but I think it is significant in that smelt contains thiaminase and we had four deaths of sea lions: we had to give them supplementary injections of Vitamin B even to get them to eat. And further mackerel and smelt were used at the St. Louis Zoo and the high unsaturated fats caused death by steatitis in crocodilians. So our whole approach at Kansas City was to get not only the Sea Eagles but the rest of the birds off the fish. We have other carnivorous birds on the bird of prey diet and flamingos as well; we feel it's pretty important. You might be interested to know how we got the birds on this diet. It looks like hamburger, but it's not ground as finely and if the bird foots it or carries it, it sometimes falls apart, but Hill's is working on a chemical process to bind it together better.

HALLIWELL. Today I brought some samples of the product we're talking about, Zu Preem. It's ground up and it comes to you frozen. When you serve it and it thaws, it becomes almost mush and they have trouble carrying it. Hill's has now added a binder to this and I have brought samples of that packed in dry ice. I'll put out their present product and their new improved product on one of the tables in the back so you can examine them.

ALLEN. In introducing the birds to the product, we didn't really have any difficulties except with one Bateleur Eagle; she still hasn't accepted it as the sole ration. We accomplished it in various ways. Birds that had been kept on horse meat took it right away, the Sea Eagles accepted it in a week. We chopped fish with chunks of Zu-Preem; we even took the viscera out of rodents and stuffed it with Zu-Preem; it works. You'd be surprised how fast you can get them on it. We had one Kestrel on the diet for 16 months; it was killed by a predator. The other Kestrels in the zoo now have been on it about four months, so we feel we've greatly improved the diet because prior to this these birds were fed chunks of horse meat, typical zoo approach to raptors which we've already talked about. Growth is a factor of Zu-Preem that we haven't gotten into. Some young raptors were raised on freshly killed rats; as soon as they left the nest, we started transferring them over to Zu-Preem. We did have three downy Horned Owls brought in this year that we raised on Zu-Preem, and they were beautiful birds, had good color, appeared normal, and had no bone abnormalities. And

we also feed roughage once a week, rats and mice as supplement. Frank Kish, former Curator of Birds at Topeka, said the Golden Eagles that bred and raised offspring this year have also been maintained on this diet. And he says that the castings are normal without any supplementary feeding, but he didn't raise this eagle on Zu-Preem, he raised it on rats. We don't have anything much to say about the growth.

THACKER. Did I understand you correctly? You said you transferred some of your fish eating eagles from a fish diet onto the Zu-Preem diet. Have you found that the birds prefer this diet to a fish diet?

ALLEN. No, that's interesting. If you offer them any other food in connection with the Zu-Preem, they will eat the other food first. They will eat fish first, rats, not horse meat; they completely ignore horse meat.

McINTYRE. I can make one comment on this. I talked the salesman out of a case for a trial and the birds I've got won't eat it. I'm sure that I could get them on it in time, but it's real difficult to feed a bird in your fist with this Zu-Preem, I can tell you that.

HALLIWELL. I'm not about to suggest to any of you that this hamburger stuff works very well tied on the end of a lure swung around your head at the end of a ten foot cord. All your nearby friends will look like they have been through a hamburger melee. But I think all of us do put our birds up for the molt. The feathers and the other portions of the body will benefit from this diet. I think you cannot find a better diet to molt your birds out on.

ENDERSON. Is any casting formed with Zu-Preem?

ALLEN. Frank Kish of Topeka in the International Zoo Yearbook, Volume 10, states that castings in Golden Eagle were normal with a strict diet of Zu-Preem; now I'm quoting him. I can see that in Kansas City we feed once or twice a week whatever the schedule is, rats or mice.

VOICE. A normal casting would have feathers and things like this—what would be castings in Zu-Preem?

ALLEN. In Zu-Preem, there are whole chunks of bones and skin, but I have to confess I haven't tried analyzing the castings at all.

HUNTER. Now one of the things that you talked about was the dietary dry matter. I really don't understand why that is important if all you are going to do is increase the intake.

HALLIWELL. Dry matter does several things. Dry matter is a portion of this

casting. It is also methyl cellulose that is being utilized as a binder to hold this mush together. Binder can also be and in this particular case which is the only one I am familiar with, Zu-Preem is a fiber base that just provides extention to the stomach. Really, many of us could get along quite well on an astronaut diet of pills and a little bit of juice.

MENG. I am going to say something about casting. Some birds would be killed by giving them too much casting. A Sparrow Hawk, for example: if you feed them mice, they'll sometimes swallow all that fur and what does the fur do in the stomach? It just fills them up and they don't desire to eat any more. If you skin the mouse out, then they eat too much and they'll have that much more food in there. One thing that hasn't been brought out, if you feed this ground up material, I just don't feel right feeding my birds something like that; I want freshly killed pigeons, they're warm. I cut the head and crop off to avoid this trichomonad problem and the feet off, too. The birds just enjoy plucking the feathers off and eating this fresh material and I wouldn't subject my birds to these meat patties. I just can't see it. They have to have something like in the wild.

HALLIWELL. I certainly can sympathize with you and agree with you very well, but the point of this meeting as far as I'm concerned, is to improve captive breeding of raptors, and if this means feeding them horse manure that we can preserve this species, I'm going to be out there with a pitchfork!

STODDART. I agree. Whatever is possible to keep the birds alive so we can breed them, I'm not trying to cut any corners. What I want to know: has anyone fed this stuff to a Peregrine for three or four years? I have a Peregrine that is seven years old that was just given to me for breeding purposes and the bird was given Zu-Preem for two years, the last two years. That Peregrine does not have the feather quality, foot quality, or anything like it should be, and I've been pumping whole birds into it and the change is phenomenal.

MENG. Just one quick comment. When these birds feed on, say, the backbone of pigeons, they are constantly wearing their beak down, and there are many birds like my Peales' that I couldn't catch and cope their beaks off, it would upset them too much. By feeding fresh material like this where all the bones are there they have to pull their beaks are down. My Red-tail is 25 years old, I've never touched her beak, she's been living on pigeon heads for 25 years, all the pigeon heads I pull off.

GOBEN. I have something on the birds and their beaks growing and eating this pattie routine. I was feeding a lot of beef heart for a while, at one time I had a bird grow a long beak, and I threw in a rib of a deer; it was a Peregrine, and that thing just messed around with that thing until its beak wore down, it looked beautiful.

HALLIWELL. Thank you. Dave Allen, do you have anything to add to that?

ALLEN. Well, prior to 1968 in the zoo these birds, a lot of eagles, they had a lot of Golden and Bald Eagles then that were shot up, Fish and Wildlife Service brought in, were fed straight muscle horse meat. Now they survived for five to ten years without any casting material. So it occurred to me from a zoo standpoint, exactly what is the relationship to health of the bird and casting material? I've never understood this and we've gotten a lot of arguments about it. I am sure there is a relationship.

VOICE. Can we get an answer on casting? We have no definitive answer, we are all around the subject.

HALLIWELL. I think there is no definitive answer. I have no personal answer myself and I think from the wise rash of discussion, unless you've got scientific facts all you are talking about is hearsay and personal experience, and hearsay and personal experience hasn't been doing it in the past and it probably isn't going to do it in the future.

PATUXENT BIRD-OF-PREY DIET

PORTER. I'm here basically as an ecologist who has been involved in the breeding of American Kestrels, primarily. We do have a group of Peregrines that we are attempting to breed; these are tundra birds. I am from Patuxent Wildlife Research Center. We have done some work with Kestrels. We started a colony of Kestrels there in 1964 for the purpose of carrying out experiments with pesticides and we are still maintaining this colony. So far as their nutrition is concerned, we started out there, this was before my time, giving the birds ground beef which was primarily muscle, mixed with some liver and tongues and parts of beef supplemented with vitamins and minerals, and then we incorporated turkey breeder crumbled for the purpose of soaking up the excess fluids; these were ground up. Then the next diet that was used starting in 1966 was a horse meat diet supplemented with vitamins primarily with Vionate. The first year of reproduction in 1965 was fair. There were quite a number of the eggs hatch, and young were produced, but the adult birds ate a number of the young. They even captured some of the young after they had fledged, so there was something awry there somewhere. Then in 1966 with the horse meat diet there was little if any reproduction. There was also a foul-up, so to speak, in the behavior of the birds because in some the males were tethered after the females laid their third egg. The males were tethered because it was thought that in 1965 the males were responsible for the killing and eating of young birds and the destruction of eggs. This was before I arrived on the scene and the reproduction was nil. We had only a few birds hatch eggs.

In 1967 just prior to the nesting season, I placed the birds on a diet containing whole white rats, one third part, whole white hamsters or mice one third, and

one third part chicken necks. We removed the skins from the chicken necks to get rid of the excessive amounts of fat and I am not sure after learning what Dr. Halliwell has to say that this was a good idea. We included chicken heads, and we put one-sixth part. And we put them in a large cutter-mixer, Hobart cutter-mixer and cut them up into a very fine texture. Then we added to a 22 kilogram batch 75 grams of Vionate, well known vitamin supplement, and 126 grams of bone meal to give just in case the calcium-phosphorus content of the diet was insufficient. By utilizing this diet we obtained a reproductive success in the first year it was used equal to that which you would expect in wild Kestrels. And it turned out to be very successful. However, in the second year with this diet we ran into embryonic mortality in the colony, and we determined that at least part of the embryonic mortality was due to bacteria entering the egg and apparently killing the embryo. When the eggs are laid very early in the season they develop a film of condensed moisture around them and the bacteria enter from the nest box and apparently multiply in the egg and kill the embryo; however, there were a number of eggs that have not shown this. We have been unable to culture bacteria from eggs and we don't know just what to think about those. This situation has worsened in recent years. We have sterilized thoroughly the nest boxes prior to nesting seasons, put clean nest material in and still we get some embryonic mortality. This last year, 1971 breeding season, the embryonic mortality was quite bad. So after what Dr. Halliwell said I think that our diet, our ground diet may be suspect, I think it should be given a very thorough chemical analysis to determine whether there were deficiencies in the diet or not.

We have given our birds water, we have placed water trays on heaters throughout the winter so the water is available. Sometimes the birds had no water. At least they had water in the winter but we had no heater under the water pan and we viewed no detectable difference in their reproduction or in the birds.

We have been feeding our Peregrines this ground rodent and bird diet. Some birds have taken to it rather readily. One particular female, a large female that was captured off the beach at Assateague, very voraciously accepted it; within the first day it was accepted. And another female trapped the same day on the beach took literally weeks to accept this diet. We now feed our Peregrines white rats during the non-breeding season supplemented with an occasional Coturnix Quail and an occasional Mallard duck. We do not feed them the Kestrel diet. I don't know just what to say about the ground Kestrel diet. It has been very successful in the past but as I have indicated I believe that it is very much in need of a good chemical analysis to determine just exactly what it has in it, what might be missing to cause our unexplained embryonic mortality. It may be due to this factor. We have tried Vionate. I think Vionate is an excellent diet supplement. We got good hatchability with Kestrels using Vionate. The shells of the egg appeared to be in somewhat better condition than with our regular Kestrel diet; this is just from cursory observation. However, after hatching we have had problems. I shall leave this to the final discussion on Health and Nutrition of the Young.

OTHER FOOD FOR CAPTIVE RAPTORS

McINTYRE. I suppose you all know that I'm from the Air Force Academy. When I took over this job they were feeding these birds nothing but frozen beef hearts. Well, me being a neophyte in the falconry business, I couldn't see feeding these birds beef heart as a complete diet. Every once in a while, maybe once a year, they'd go out and get some pigeons and feed these birds pigeons. Well, a month after I took over, I threw out 400 pounds of frozen beef heart. You know, I can do this, being a veterinarian; I declared them unfit for human consumption and threw them out. At first I started using quail, Coturnix Quail. Then the guy I was buying the Coturnix Quail from got outrageous in his price and we started using our own chickens. We'd get day-old chickens and raise them to three weeks. The feed we were putting into them, the only non-medicated feed that you can put into a chicken, I think, is game bird feed. Actually the medicated feed has about 3% Auromyacin in it and I cannot see that this is going to hurt any bird of prey. I also used a water soluble multi-vitamin, it's called Head Start, and put this in the water of the chicks. This way I don't have to worry about giving my hawks multivitamins. During the winter time, since I have access to the hospital at the Academy, I get a bottle of multivitamins and shove a tablet down the birds every other day. Of course, I noted a great improvement in the condition of the birds and the sheen of the feathers and so forth, so I thought that we were on the right gimmick, and we've had some birds now that we've had for six, seven, eight years that have been on this chicken diet almost exclusively. Occasionally we feed them some venison that we get off a road kill at the Academy. Of the breeders that we have, a pair of anatums, the tiercel we had was in lousy shape when we got him. He was supposed to have been five years of age. His feet and cere were completely white; he couldn't jump off the ground to a block perch. Two weeks after we had him on a strictly chicken diet, and we fed the whole chicken, just took nothing off. We have learned now to cut the feet off because the Peregrines particularly won't eat the shank of the legs and this saves the cadets from going around picking them up. Now we got eight eggs out of the Peregrine last year in two different clutches. The tiercel did not have much to do with it, but I think it was because he was in such lousy shape when we got him. I am looking for better signs this year, hopefully, than we had last year, because he is in real good shape. Now we fly him on a string, and we jump him straight up, and he's in pretty good shape. And he is real tame, you can put him in your coat pocket, carry him any place you want to. Sometimes we take him to football games and we never tie him up in a hotel room. Of course this shakes a lot of people up—they walk in there and there is a Peregrine sitting on the back of a chair. I think, I hope this is an adequate diet. After looking at these figures Bill gave, I am not too sure. In the breeding pen of course we keep a bath of water which was a wading pool; we try to keep it full of water all the time. Fortunately we're lucky we have water available; the big problem is that it freezes in the wintertime. So this is about all I have on the nutrition of these birds.

HUNTER. What would be the cost? Would the cost be prohibitive to do a comprehensive assay on four week old chick? And wouldn't it be fruitful to do so?

HALLIWELL. I think it probably would be fruitful to do so. I don't know whether I am capable of doing it or not, but I will certainly check into it and see.

TEMPLE. We have the nutrition people at Cornell doing an analysis of day old chicks, horse meat, and the various things that we are feeding the birds. They are doing one at a time. They started on the day old chicks and the four week old chicks. This information should be available soon.

THACKER. I just want to make a comment on thiamine deficiency in Peregrine Falcons. Bill was saying that Prescott Ward diagnosed it in a Peregrine Falcon last year which was in *AVMA Journal.* Near Ohio State there is a bird sanctuary. It's run by one of the Audubon groups and based on Prescott Ward's article all of the birds fed there are fed on chicks; this is cockerels up to 12 days old. They get them from a local dealer, kill them and feed direct. And these birds have been on these chicks now for at least a year and a quarter to a year and a half. And in the last four months we have had two Great Horned Owls, a Red-tail, a Red-shoulder, and a Prairie Falcon all exhibiting signs of thiamine deficiency. That is one point I wanted to bring up about chicks.

SWARTZ. I have my own conviction about snowshoe hares—they're poor food. Would you comment on beef heart?

McINTYRE. Beef heart of course, I think we're all agreed, but maybe not, basically is low in calcium and phosphorus. Of course, with beef heart you get no castings at all. I think you can supplement an adequate diet with this occasionally, an adequate diet of pigeons, chickens, maybe rats. I'm sure that people who feed pigeons regularly feel that this is the best diet. And I can't argue with them. The only argument I've got is that you always have to worry about trichomonas or frounce. And since people don't want to disturb breeding pairs particularly you are taking a chance to lose a bird. Of course I am a great believer in casting material; this is why we have gone strictly to the chicken. And it's a whole chicken, feathers and all, and they get good castings every day. I would stay away from wild birds because I don't know how much pesticide they may have in them: Starlings and so forth. Dick Graham, I think, had some chickens analyzed that he is raising. And three of us in the Colorado Springs area have chickens from the same hatchery. I forget now, but I think he said the highest part pesticides was in the liver, about .03 parts per million. Is that right?

GRAHAM. Yes, that was the highest of the whole business.

GALICZ. For the last few years I have been experimenting by feeding strictly rabbit heads. These are strictly fresh rabbit heads acquired fresh at the butcher's three times a week and each pair of Peregrine receives three heads per day. They appear healthy, they have extremely good egg production both last year and particularly this year. One pair had as many as three clutches and incubated all three, but there is a problem of fertility. Now what is the answer, this is my question.

HALLIWELL. I won't try to pick out specific factors, but I certainly think you are not feeding a whole animal diet. One thing you are missing and you haven't seen it in these birds yet, maybe they are picking it up someplace else. Dr. Prescott Ward at Edgewood Arsenal in Maryland a year ago diagnosed a case of thiamine deficiency in a Peregrine Falcon, most of you are familiar with the work. So far as we can tell, the only place that thiamine is found in the natural diet of birds of prey is in the intestinal tract, in the ingesta of the intestinal tract, so I would say you are missing this. I frankly think you are missing quite a bit.

GALICZ. They are producing eggs, and they are beautiful eggs; the birds appear healthy.

HALLIWELL. These eggs, have you checked them? Have any of them been fertilized?

GALICZ. Last year there was a possibility that one hatched but it is not conclusive. The chick disappeared, that was the only case but it is not conclusive. It appeared to be there, but four days later when I actually checked back the other three eggs were there and they were rotten, they were not fertile.

HALLIWELL. My comment to you would be to switch diets and I don't know where you're going to switch to.

GALICZ. My reason for feeding the rabbit heads was because I was assured they were reasonably free from various pesticides; these people were feeding very carefully. The only other thing I did use was Vitamin E at one period after they finished setting and 14 days after nesting they immediately laid again. Now whether it is the Vitamin E that prompted the laying so quickly after incubating, I don't know.

MENG. I feed my birds pigeons; I take the two breasts off and then give them the backs and the intestines and all the gonads of mature pigeons. They seem to get the hormones from the gonads they feed on. So if you could do that in addition to the rabbits perhaps that could be the answer.

GALICZ. I'll give it a try next season.

HALLIWELL. Why not just combine, feed two or three varied diets.

NELSON. I have a possible answer to George Galicz's question, and Dr. Meng might have some suggestions or ideas here. In birds in the wild the female for several weeks prior to egg laying doesn't get any heads. The male eats the heads, brings the rest to the female in courtship feeding activities. The female, while she is laying and right through apparently until the chicks are a couple weeks old, doesn't get any heads or virtually none, although there may be some. Now Dr. Meng might have some ideas here and others who have fed whole prey items. Do the birds select certain parts from their kill? I think they do and certainly if you could arrange it to feed them whole pigeons the birds are going to medicate themselves. They've done this for millions of years.

SWARTZ. I would like to comment on the point of varied diet and also to parasites; I've been playing a trick lately. Skip Walker is our stock feeder in maintaining our mouse colony, when they get to a certain size I take over the feed lot operation and feed them up on laboratory chow, then take them off of the laboratory diet and put them on pure carrot. The skin then turns yellow in just three days. This may serve to flush some of the bad things out of them in this way. The Merlins for example get one of these mice every day; this does produce a very lovely yellow fat, interesting yellow ceres. The feet are also yellow; it's been, so far, very satisfying and solves this intestinal problem, too.

HALLIWELL. I would like to have Mr. Kent Carnie talk about his birds that have gone on a more adequate diet, and you can even see the difference in the tail feathers.

CARNIE. I was flying an intermewed passage European Goshawk. She had been fed on a diet in essense of what she caught, jackrabbits, all last winter. She took straight muscle plus heart, that was it. She seemed healthy, she flew extremely well, the diet was fine, her appetite was fine, but midsummer she came down with what I would have said was frounce ten years ago. However, there were no trichomonads. She might have had spots in the lungs, it might have been aspergillosis, but it seems very possibly that from this straight meat muscle diet it might well have been the vitamin deficiency, something that Dr. Halliwell published about in *Hawk Chalk;* it sounded like Vitamin A. Anyway we tested for aspergillosis, we treated for frounce, we treated for vitamin deficiency. At the same time with the vitamin deficiency, I gave her one-a-day vitamin tablets, first daily, then every other day, then twice a week. I changed her chow from straight jackrabbit muscle to an entire pigeon cut up in pieces which unfortunately at that time had to be forced down her throat. This bird went entirely off her feed; she had to be force fed for nine days straight. She went from 50 to 44 ounces and things looked bleak. Nine days straight, she finally bottomed out at 44 and began to perk up. Up to that time incidentally her feet were pale gray and very, very scaly and very dry in contrast to the yellow

waxy feet of Al Nye's Gos for example. He had her on a diet I'm not familiar with, I think young chicks. Incidentally I tried the chick route with this bird, she just won't have it. Prior to this disease she had shown a perfectly normal molt except that she had only dropped her decks and she dropped nothing else in the train. With the onset of the disease and the change in diet, she began to snap out of it, she dropped her train. You can now look at this bird's train and see her decks in comparison with the brand new feathers. They are as different as night and day. The feathers are drastically different in color, in quality, in brittleness and this thing speaks to a natural diet to me. It is my fault she got into this condition. It is because of Raptor Research Pathology Committee that she is alive today. It surely shows by looking at this one bird's train the visible evidence of the different environment.

HALLIWELL. Most of the people raising birds of prey or keeping them in captivity have been feeding a somewhat jury-rigged diet containing either chicken parts or chicken wings or something like that and trying to supplement the diet with products, usually veterinary products such as Vionate and diet supplements. And I wondered if you would discuss for a moment the rationale of trying to supplement a basically inadequate diet by adding to it these supplements. In other words what is your opinion in this direction? My personal approach is to try to put into the diet to begin with everything you need, in other words to try to provide in the diet by what you are feeding rather than supplement, let's say, horse meat with large amounts of Vitamin E, Vitamin A, minerals, and so on down the line. Do you understand?

CARLSON. A number of years ago we used to do what we call a free choice feeding along with our poultry feeds and we put several things out there for the birds to pick at. We found that most of them might do a fair job, but there were always those few that were just too gluttonous in eating all grain or all mash or all this or that and wouldn't really balance their diet and so we came to the conclusion that it was necessary to put everything in one meal and I think that is what you were getting at. And so I think where you have considerable investment that this is the way I would go. I would try to formulate a complete ration and expect the animal to get that. Of course all of one thing—they may not like it, it's not very much variety, but we have found in commercial poultry production that that is what gives us the return.

CAMPBELL. Would you care to comment on egg yolk as a source of vitamin, trace minerals, and supplementary food for raptors?

CARLSON. As a poultry nutritionalist I would have to say that egg yolk is the perfect food. It does contain all the essentials at least for the growth of that embryo throughout that period that it is in the shell and even for a few days afterward. Generally there are pretty fair quantities, so I would say that egg yolk ought to be a good supplement.

HALLIWELL. Quite a few people have been feeding day old cockerels to their adult raptorial birds. Would you comment on what you think the nutritional value is of day old cockerels?

CARLSON. They still have a good amount of egg yolk in them. Then again you are getting about everything that was in the egg to begin with except the loss of a little oxygen and maybe some other things that volatilize. It should be a pretty fair diet.

HALLIWELL. Do you think that this would be a nutritionally staple diet again considering carbohydrates, fats, proteins, minerals, vitamins, to maintain the healthy bird?

CARLSON. It should be.

VOICE. Isn't a four week old chick more nutritional source of food than a day old chick?

CARLSON. I would say that a day old chick would be better than a four week one. The only reason I would say that the other bird is not quite as good is that we have diluted it perhaps with nutrients that your raptor is not going to need. Zinc, for example. You don't build up much zinc in that bird and yet the day old chick probably contains a lot more in parts per million.

HALLIWELL. What would you think of the mineral contents of day old chicks? What I'm really trying to say is that this chick had to utilize metabolically many of the nutrients that were in that egg the day it was laid in order to create a baby chick at the time of hatching. What is the relationship of this to a chicken that has grown to four or so odd weeks on an adequate diet?

CARLSON. Well, there is one thing that the day old chick would not have and that is calcium and phosphorus. Even though the shell is almost 100% calcium carbonate, not much of it gets into the chicken itself. The bones are practically all protein; there is very little calcified tissue there. Certainly the older bird would be much better for the massive minerals, in other words calcium, phosphorus and so on. Other than that I think you would be better off with the day old chick.

SHERROD. It seems to me that since they naturally prey on older birds, it would seem natural to use other than day old chicks.

CARLSON. This is true. Certainly the older bird is probably going to be a pretty good diet. Maybe as good as the bird needs.

EBERLY. I read one report by a gentleman, I believe in Europe, who had

success breeding owls and he switched his diet over to cockerels, probably around five weeks old, and he did not have success that year. He thought maybe it was because he had used medicated pre-starter for the chicks. What do you think of that?

McINTYRE. I really don't know, but I don't see the logic behind this. The medication in this medicated feed is so small, it's 3% aureomyacin and you try to correlate this and say well there probably wouldn't be so many humans on earth if this had something to do with fertility, because there are a lot of people that get shot with antibiotics today and a lot of people take it orally without a prescription or with a prescription and this is the only basis I know, I really don't know.

EBERLY. Is that all that's in it, aureomyacin?

McINTYRE. That's all that's in it.

HALLIWELL. If you have something else to add on medicated feed we'll listen to you.

FYFE. I was under the understanding that some of the things that are going into chicken starter and turkey starter include arsenic in very small quantities, and I wonder if this would have any effect or should be of a concern as far as the next step up in birds of prey which would concentrate something like this.

HALLIWELL. Yes, everything you have said is true. My only answer is they are dumping just as much in the rivers and on the fields and the prey species contain some also. Beyond this I am unwilling or unable to comment.

SMYLIE. What I would like to know is, in this starter feed are coccidiostats in there? Are there any hormones or anything else that could be carried through to show changes in the raptors? Also what is the amount of DDT found in commercial chicken, etc., that is available at the grocery store now?

CARLSON. Well, as far as the chick starter being carried over to the raptor, I don't believe there is anything there that you need to worry about as far as hormones are concerned. We don't add hormones at the present time. We do have antibiotics and coccidiostat to cut down on coccidiosis. But at the level it is used and by the time it goes through the bird I'm sure that this would not interfere with the bird that you are concerned with. As far as the amount of DDT and other chlorinated hydrocarbons in poultry, undoubtedly there is some but Food and Drug is doing a pretty good job in terms of monitoring this and I don't think it's going to hurt you as much to eat that bird as it hurt the bird in the beginning. In other words we find that avian species are much more susceptible to chlorinated hydrocarbons than people are. Of course that brings another

question—do we get enough in them to hurt your bird? That's entirely another subject. At the present time under conditions where we do have control over our animals I don't believe this is a problem. If, for example, you have your aviary close to where they are burning some transformers, I would be a little bit concerned about PCB's and things.

GALICZ. I understand that stilbesterol is used in some cases to promote rapid growth in poultry. Now if such poultry was fed to the hawks, would this cause sterility?

CARLSON. If you fed nothing but livers I suspect after a few years this might be a problem, but normally I don't think so. We used to be able to inject a pellet into the bird but this was prohibited about 15 years ago. Now the only way we can get into a bird is through the diet or through the drinking water and then in very minute quantities. I don't think it would be a problem. Then you might be concerned with feeding a lot of cow liver or something where you're getting a real potent supply.

TEMPLE. In this regard, too, all of the steroid hormones including diethyl stilbesterol in the chickens that you would be feeding to your hawk is fairly rapidly broken down. The residues that would be in birds will probably be so small, unless you were giving a massive dose I wouldn't worry about it.

GALICZ. The reason I was asking that is, at one stage I happened to be engaged in commercial mink farming and some years back in Canada we did have some serious problems with lack of production in mink directly due to feeding chicken.

CARLSON. But you fed them the whole head and that head had a pellet in the back of the neck so they got a real slug of it.