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On Some Influences of Air Pollution on Respiratory System of Captive Wild Animals

1. On the Histo-morphological Classification of Anthracosis

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Introduction

The suspended particles in atomsphere not only affet the loss of an animals, plants, prosperities and clothes but also affect the health of man. There are many reports that the suspended particles give serious abstacles to man and animal anthracosis especially and it gives rise to lung cancer of animals, The coal dust in suspenod particles infiltrate on the lungs of man and animals and they compose the anthracosis. In man, the anthracosis is known for occupational disease. These particles are often made by nature, but most of them come from the combustion of coal, Petroleum, and wates, from production equipment, and from the car exhaustion. The mean of volume of suspended particles in Seoul is 23.7ton/km². month, and the maxium is 63.8ton/km². month. Men and animals intake many perticles, so they stimulate on the anthracosis seriously, but the study of effect contains many problems untill now. The study of effects on man, pet and zoo animals should be examined and th sanitational research of breeding animals should by esamined necessarily too. This study will examined closely the effects on the animal anthracosis as well as will offer the important resources to study the effecton man. Man used the dogs as objects to measure the effects, without when other experimental animals are used, from old time, because the dogs live in the similar circumstance to that of man and live in the limited moving category. There are many reports to examine the heavy metal pollution, degree of anthracosis and lung cancer of dogs in the finding of the histo-morphology in Japan. The Japanese also study the measurement of degree of anthracosis infiltration of zoo animals in captivity and lung of pigeon. In this study, the effects of air pollution on the breeding animal anthracosis in Chang-gyeong Weon Zoological Garden. anthracosis especially, are examined.

Materials and Methods

The sample lungs of animal which were dead when bred in Chang-gyeong Weon Zoological Garden, and other pigeons were also prepared (June 1973-June 1975).

The sample was composed of 200 birds, 28 mammals, and 3 reptiles (Table 1).

Dead animals were autopsyed quickly and the lungs were extracted. The lungs were fixed in 10% formalin solution. For mammals, the lungs containing lobe, pleura and trachea, were extracted and for birds, lobe. Then samples were embedding with paraffin, and sliced. The sliced sample were stained with Hematoxylin Eosin heavily and micro finded. Micro finding of air sac of bird was not examined. The state of particle infiltration of mammals differed from each other by macro finded because mammals had the different anatomic structure between species. So, the criteria of classification of anthracosis was not established. the classification of anthracosis of mammals followed that of dogs.

Table 1. Breeding Animals Examined and Number of Cases with Anthracosis (June 1973~June 1975)

Class	Order	Number Examined	Number of Case
Mammalia 포유강	*Marsupialia* 유대목	2	1
	Primates 원숭이목	2	2
	Carnivora 개목	11	11
	Artiodactyla 사슴목	8	6
	Perissodactyla 말목	5	5
Subtotal	5	28	25
Aves 조강	*Struthioones* 타조목	1	1
	Sphenisci 펭킨목	2	1
	Ciconii 백로목	7	7
	Anseri 기러기목	6	4
	Falconi 매목	2	1
	Galli 닭목	8	6
	Grui 두루미목	5	3
	Golumbi 비둘기목	158	114
	Passeri 참새목	3	3
	Podicipedi 논병아리목	1	0
	Scansores 왕부리목	2	1
	Bucerotes 코뿔새목	2	2
	Strigi 올빼미목	2	0
	Gavii 아비목	1	1
Subtotal	14	200	143
Reptilia 파충강	*Crccodilia* 악어목	1	1
	Testuines 거북목	1	1
	Squcmata 뱀목	1	1
Subtotal	3	3	3
Total	22	231	170

The histological place of infiltration of birds was researched around the tertiary bronchus. The criteria fro masurement of anthracosis of bird was as follows(Fig. 1).

1) Negative; None infiltration 2) Low degree; Small infiltration on tertiary bronchus and very small infiltration on secondary brochus. 3) Mild degree; Concentrated infiltration on tertiary bronchus but no coagurated infiltration. 4) High degree; Coagurated infiltration.

Results

Infiltration of Dust Classified by Macrofinding : 14.3% of 28 mammalia had anthracosis. The 4 mammals were horse with 44 months breeding period, Sika with 7 months, Polor Bear with 21 months Slow Loris with 21 months.

The traces were in the types of black petechiae, vibices. The 1 case in birds and no cases in reptiles was noticed.

Infiltration of Dust Classified by Macrofinding : 9.3% of 28 Mammalia, 71.5% of Aves, 100% of 3 Reptilia had the anthracosis among total 231 cases (Tab. 1). Among the cases of the anthracosis, the high degree of anthracosis were found in 3.9% mild degree 14.3%, and low degree 55.4% in mammals, the particles were found at alveolor cavity alveolar region of blood vessel and connective tissues in lung and in pleura and combination structure below pleura. Generally, the volume of

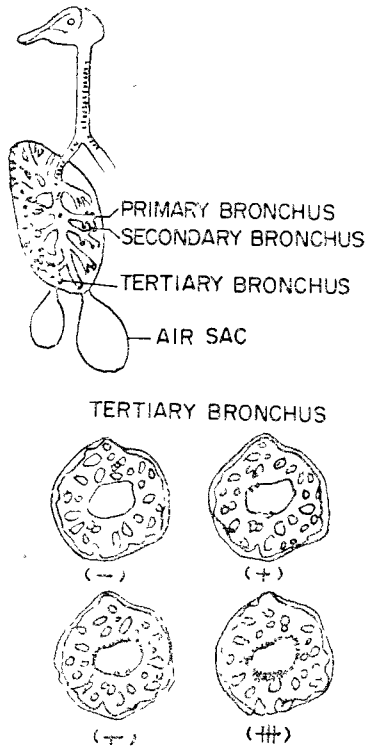

Fig. 1. Classitication of bird anthracosis.

just increased the more infiltration at interior intervals of lung increased, and the increased volume of particles caused coaqurated infiltration gradually. In Aves, the most particles were found at secondary and tertiary bronchus, and the small volume of particles were found at capillary alveolar system, membrane of bronchus and inflammation place. The particles were also found at tertiary bronchus in low degree.

Infiltration of Dust in Lung and Breeding Animals : 89.3% of mammalia had anthracosis. 60.7% of cases showed low degree. 25% mild degree. and 3.3% high degree. 71.5% of Aves had anthracosis. 54% of cases showed low degree, 13% mild degree 4.5% high degree (Table. 2). Degree of infiltration in mammalia and Aves were different in part ($P(x^2)<0.05$).

Infiltration and Breeding Period : The animals showed the tendency of higher degree of lung contamination acoording to the progress of breeding period. 53.8% of 39 animals with less than 1 year breeding period had anthracosis, 74.5% of animals had with from 1 to 2 years of breeding time and 87.2% with more than 2 years of breeding time. Especially in animals showed high degree(Table 3).

Infiltration and Breeding Place : Breeding places were divided into in-quarter and out-quarter.

Table 2. Degree of Anthracosis in Birds and Mammals

Degree / Breeding Period at Zoo(Year)	Mammals					Birds				
	−	+	++	+++	Total	−	+	++	+++	Tatal
0	1	5	1	0	7	17	13	1	0	31
1	0	2	3	0	5	36	82	20	1	139
2	1	4	0	0	5	2	4	0	1	77
3	0	1	1	0	0	2	6	1	1	10
4	1	1	1	0	3	0	1	2	0	3
5+	0	4	1	1	6	0	2	2	6	10
Total	3	17	7	1	28	57	108	26	9	200
%	10.7	60.7	25.0	3.6	100.0	28.5	54.0	13.0	4.5	100.0

$x^2=4.01$, $P<0.05$

Table 3. Degree of Anthracosis According to Breeding Period

Breeding Period at Zoo(Year) \ Degree	−	+	++	+++	Total
0	18	19	2	0	39
1	37	85	23	0	145
2	3	8	0	1	12
3	2	8	2	1	13
4	1	2	3	0	6
5+	0	6	3	7	16
Total	61	128	33	9	231
%	26.4	55.4	14.3	3.9	100.0

$x^2 = 89.07$ $P < 0.01$

Table 4. Degree of Anthracosis According to Breeding Condition

Breeding Period at Zoo(Year) \ Degree	In-Quarter					Out-Quarter				
	−	+	++	+++	Total	−	+	++	+++	Total
[illegible]	10	10	3	0	23	8	8	0	0	16
[illegible]	1	2	0	0	3	36	82	23	1	142
[illegible]	0	2	0	1	3	3	6	0	1	9
3	0	1	1	0	2	2	7	1	1	11
4	0	1	0	0	1	1	1	3	0	5
5+	0	2	1	0	3	0	4	2	7	13
Total	11	18	5	1	35	50	108	29	9	196
%	31.4	51.4	14.3	2.9	100.0	25.5	55.1	14.8	4.6	100.0

$x^2 = 0.54$ > 0.01

Table 5. Comparision between Chang-gyeong Weon Zoo and Ueno Zoo on Anthracosis of Birds

Breeding Period at Zoo(Year) \ Degree	Chang-gyeong Weon Zoo					Ueno Zoo				
	−	+	++	+++	Total	−	+	++	+++	Total
0	17	13	1	0	31	58	51	14	7	130
1	36	83	20	0	139	4	10	16	2	32
2	2	4	0	1	7	1	4	10	4	19
3	2	6	1	1	10	0	0	3	4	7
4	0	1	2	0	3	0	2	1	8	11
5+	0	2	2	6	10	0	1	6	19	26
Total	57	109	26	8	200	63	63	50	44	225
%	28.5	54.6	13.0	4.0	100.0	28.0	30.2	22.0	19.8	100.0

Table 6. Comparision between Korean and Japanese Pigeons on Anthracosis

Degree / Breeding Period at Zoo(Year)	Korea					Japan									
	Chang-gyeong Weon zoo					Noncontaminated Area					Contaminated Area				
	−	+	++	+++	Total	−	+	++	+++	Total	−	+	++	+++	Total
0	5	2	0	7	7	19	16	0	0	35	130	112	25	4	271
1	36	20	20	0	136	17	11	2	0	30	17	49	26	9	101
2	1	2	0	0	3	13	8	3	0	24	4	36	22	10	72
3+	2	9	1	0	12	1	6	2	0	9	4	11	10	7	32
Total	44	93	21	0	158	50	41	7	0	98	155	28	83	30	476
%	27.8	58.8	13.4	0	100.0	41.0	41.9	7.1	0	100.0	32.6	43.7	17.4	6.3	100.0

68.6% of in-quarter breeding animals had the anthracosis and 74.5% of out-quarter breeding animals showed anthracosis. Significant differences according to the breeding places were not Noticed($P(x^2) > 0.1$).

In in-quarter dreeding animals, 51.4% of animals showed low degree 14.3% showed mild degree and 2.9% showed high degree. But in out-quarter breeding animals 55.1% of animals showed low degree 14.8% mild degree 4.6% high degree. (Table 4).

Discussion

The measurement of volume of dust in animals lung showed the similar effect of air pollution on man. But the detection of particles by air pollution in man's lung is nearly impossible because of the difference of job, smoking anb resident. The infiltration of dust in man's lung lead the resistance of respiration, decrease of breathing capacity, upper bronchitts, bronchitis, and acthma. Especially, the lead of lung cancer is a serious problem. The studies of infiltration of dust and heavy metals in animal lung were announced largely in Japan. By Dashiro report, 22% of breeding animals in Japanese Zoo had anthracosis. Domparing two data, they had similarity (Table 5). and by Dakemoto report of pigeon anthracosis, 51% of pieons had anthracosis in non-contaminated area and 32.6% in contaminated area, but the degree of contamination in Chang-gyeong weon Zoological Gardens was higher than that of contaminated area in Japan(Table 6).

Better results will be gained by the method of histo-pathological found. Then macrofinding and there were many difficuties to classify in this study, so new method of classification should be employed. So the classification of more the mild degree should be observed closely. The metohd of Lubarsch, of Kaufmann and of Idono were widely used to classlfy the man's lung. In this study, the cases were classified into 4 steps through histological finding but in Japan 5 steps were used. The fact that no differences between in-quarter and out-quarter breeding animals were detected, was alike that of Japan as 62.5% in-quarter breeding and 74.6% out quarter breeding. The large difference according to breeding period not to breeding place occured in Chang-gyeong Weon Zoological and Botanical Gardens and Japan too. The cause of severe infiltration was a long breeding period that gave enough time to accumulate. The degree of infiltration of dust in mammlia was higher than that of Aves, but the difference was very small. So the birds like pigeons easy to get were good smaples. But it was difficult to isolate the pollution source from the lung and cross lung surface which contained plura in pigeon and to classify because of neucletic erythrocytes, The anthracosis of pigeon in Japan increased according to it's breeding period and increased sharply with more than 3 years breeding period, but degree of in-quarter breeding animals was pale. But animals that showed high degree in Tokyo were 54% in

Nagoya 40% and no cases in Seoul, 64.8% in Tokyo and 52.1% in Nagoya. The effects of air pollution on man and animal anthracosis were serious. Especially, the degree of anthracosis according to time was the serious one. so the rapid prevantion of air pollution was needed.

Conclusion

The study on the influence of air pollutants(coal dust) on lung of wild animals kept in Chang-gyeong Weon Zoological and botanical gardens was carried out 2-year period from June 1973 to June 1975. The micro and macro findings of the anthracosis of 231 captive wild animals were studied.

The obtained results were as follows:

1) The cases of anthracosis were found in 170 head (73.6%) out of total 231 heads and 3.9% of 170 animals showed high degree of contamination and rest of them showed low or mild degrees.
2) 89.3% of 28 Mammalia, 71.5% of 200 Aves and 100% of 3 Reptilia had the anthracosis. Among the cases of anthracosis, the high degree of anthracosis were found in 3.5% of Mammalia and 4.5% of Aves.
3) The animals showed the tendency of higher degree of lung contamination according to the progress of breeding period. 53.8% of the animals with less than one years breeding period had anthracosis, and 87.2% of the animals with more than 2 years of breeding period had the anthracosis.
4) Significant differences according to the breeding places were not noticed. 69.6% of in-quarter breeding animals had the anthracosis and 74.5% of not-quarter breeding animals had anthracosis.
5) Most of the animals examined showed microfindings of anthracosis and 5 heads showed macrofindings.

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大氣汚染이 動物의 呼吸器系에 미치는 影響

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초 록

1973年 6月부터 1975年 6月까지 2年間 昌慶苑 動物園에서 飼育中에 死亡한 動物과 鳥類의 肺와 收集된 네들기의 肺 231件을 對象으로 하여 肉眼的 및 組織學的으로 肺內 粉塵沈着狀態를 調査한 결과 다음과 같은 結論을 얻었다.

1. 總231件의 動物肺中 170件(73.6%)이 炭肺로 檢出되었으며 이중 高度沈着이 3.9%로서 대개가 輕度 및 中等度 炭肺로 檢出되었다.
2. 哺乳類에선 89.3% 鳥類에선 71.5%가 炭肺로 나타났으며 爬虫類에서는 3件 모두 陽性이었다. 이중 高度炭肺는 哺乳類와 鳥類에서 各各 3.6% 및 4.5%였다.
3. 飼育期間이 길수록 炭肺는 심한 傾向이 있었다. 即 飼育期間이 1年 以下의 動物은 53.8% 2年 以上에서는 87.2%가 陽性으로 나타났다.
4. 畜舍內飼育과 畜舍外飼育은 각각 68.6%와 74.5%의 炭肺가 있어 有意한 差가 없었다.
5. 肉眼的所見으로 肺內 粉塵沈着을 확인한 경우는 5件밖에 없었으며 全部 組織學的檢査로서 확인되었다.