FURTHER OBSERVATIONS ON THE RELATION OF IODIN TO THE STRUCTURE OF THE THYROID GLAND IN THE SHEEP, DOG, HOG AND OX *

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INTRODUCTION

In this report we have collected our observations on the relation of the iodine content to the structure of the thyroid to include sheep, ox and hog thyroids. It is thus only a continuation of the work previously reported¹ concerning dogs' thyroids. The methods used and the anatomic classifications adopted are the same as those fully described in the above-mentioned article and elsewhere.²

COMPARISON OF THE IODINE CONTENTS OF SHEEP, DOG, HOG AND OX THYROIDS WITH THEIR RESPECTIVE ANATOMIC STRUCTURES

The following tables are compiled from iodine determinations made on the thyroids of 40 sheep, 67 dogs, 26 hogs and 37 oxen. As the basis of these tables we have used nine anatomic groups, viz.:

1. Normal glands.
2. Colloid glands (goiters).
3. Colloid-early glandular hyperplasia.
4. Normal-early glandular hyperplasia.
5. Early-glandular hyperplasia.
6. Early-moderate glandular hyperplasia.
7. Moderate glandular hyperplasia.
8. Moderate-marked glandular hyperplasia.
9. Marked glandular hyperplasia.

The normal and colloid groups are well defined, while the remaining seven groups are purely arbitrary divisions of the hyperplasias made for the purpose of facilitating analysis, since in reality one has to deal with a continuous gradation of hyperplastic changes occurring in either normal or colloid glands. In order to express this gradation, we have used the following terms: *normal-early glandular hyperplasia* to include

* From the Laboratories of Experimental Medicine and Pharmacology, Western Reserve University.

1. Marine (David) and Williams (W. W.): THE ARCHIVES INT. MED., 1908, i, 349.

2. Marine (David): The occurrence and physiological nature of glandular hyperplasia, etc. Johns Hopkins Hosp. Bull., 1907, xviii, 359.

those glands showing the very earliest hyperplastic changes occurring in normal glands; *colloid-early glandular hyperplasia* to include glands showing the earliest hyperplastic changes occurring in colloid glands, and the terms *early*, *moderate*, *marked*, etc., to include the other gradations up to and including the most extensive glandular hyperplasias met with.

In placing these glands in these several anatomic groups, we have compared all the glands of the four animals, the one with the other, in order that the same standard of classification might obtain in all.

In each of the following tables we have listed for comparison the iodine contents of sheep, dog, hog and ox thyroids having the same anatomic structure.

TABLE 1.—NORMAL GLANDS *

Animal.	No. Cases.	Iodin per gm. dried.			Iodin per gm. fresh.		
		E.	M.	A.	E.	M.	A.
Sheep	19	4.614	2.288	2.467	1.318	0.694	0.686
		1.247			0.318		
		4.722			1.064		
Dog	3		3.205	3.322		0.757	0.777
		1.990			0.512		
		4.153			1.456		
Hog	18		2.412	2.515		0.778	0.884
		1.538			0.425		
		4.768			1.592		
Ox	17		3.254	3.461		1.069	1.117
		2.730			0.892		

* In each table E., M., A. are abbreviations for extreme, mean and average, respectively.

It will be seen that the upper extremes of iodine contents are fairly constant for all four animals, while the lower extremes show moderately wide variations, although the lowest of these lower extremes is always far in excess of the highest extremes of the succeeding group—normal-early glandular hyperplasias. This would indicate that there are considerable variations in the iodine contents within the group, even when no noteworthy anatomic changes are observed, although if individual comparisons of the iodine contents with the corresponding histologic preparations be made one can distinguish changes in the structure (too slight to warrant the introduction of a new group) corresponding to the variations in the iodine content; that is, glands with the highest iodine contents have a more flattened alveolar epithelium and *vice versa*, although all these glands appear in the table as normal.

The average iodine contents for the four animals show a surprising constancy and parallelism, viz.: 2.467 mg. for the sheep, 2.515 for the hog, 3.322 for the dog and 3.461 for the ox per gm. of dried thyroid.

The ox thyroids in our series have distinctly higher iodine contents than either the dog, sheep or hog. To know whether this is normally true would be of value in determining what relation exists between the normal iodine content and the normal weight of the thyroid, since oxen appear to have less thyroid per kilogram of body weight than do the other animals mentioned. From the experimental side it has been definitely shown that the amount of iodine in the thyroid does to a great extent control the size of the gland.

TABLE 2.—COLLOID GLANDS

Animal.	No. Cases.	Iodin per gm. dried.			Iodin per gm. fresh.		
		E.	M.	A.	E.	M.	A.
Sheep	3	3.691			1.027		
			3.529	2.996		0.974	0.818
Dog	8	1.769			0.455		
		3.608			1.039		
			1.816	1.985		0.406	0.459
Hog	2	0.846			0.132		
		2.768			0.805		
				2.353			0.681
Ox	0	1.938			0.557		

Owing to the small number of cases included, it is not possible to speak very specifically. However, in all three animals in which colloids were observed the upper extremes of iodine content are fairly constant, while the lower extremes show moderate variations. This agrees with what was observed in the normal glands, and our explanation is the same. Another point worthy of note is that, while the iodine per gram of colloid gland is in general lower than that of normal glands, yet, as will be seen, they approach nearest to the normal iodine content so far as we have found and may be raised to an equal content with the normal glands.

TABLE 3.—COLLOID-EARLY GLANDULAR HYPERPLASIA

Animal.	No. Cases.	Iodin per gm. dried.			Iodin per gm. fresh.		
		E.	M.	A.	E.	M.	A.
Sheep	4	1.000			0.282		
			0.853	0.792		0.201	0.206
Dog	4	0.461			0.138		
		1.443			0.302		
			0.953	0.945		0.221	0.217
Hog	0	0.431			0.125		
Ox	0						

Table 3 and Table 4 deal with the most important anatomic and chemical changes concerned with the production of goiter, in that they represent the first deviation or change from the normal-colloid or quiescent glands. *Colloid-early glandular hyperplasias* differ from *normal-early glandular hyperplasias* in that the former are *secondary*³ hyperplasias, while the latter are *primary*. It is to be regretted that more colloid-early glands were not obtainable (the probable reason for this will be pointed out later). The extremes show a fair constancy. In the sheep the highest extreme iodine content is below the lowest pure colloid extreme. In the case of the dog this is in general true, though there are exceptions which we are not able to explain. The existence of these exceptions suggests, however, that from the histology alone one is unable to say whether a given gland is undergoing further hyperplasia from a less marked hyperplasia or *vice versa*. The averages also are constant and in every instance show the great drop in the percentage of iodine from that of pure colloid glands. This drop is, as will be seen in Table 4, identical with that occurring between the normal and normal-early glandular hyperplasia. Between no other groups are there comparable drops. This means that in both colloid and normal glands there are wide variations in the amount of iodine present, but that there is a quite constant lower limit of the iodine content necessary to maintain normal gland or pure colloid gland structure, and that this lower limit for colloids is slightly in excess of 0.217 mg. per gram of fresh thyroid for dogs and 0.206 mg. per gram of fresh gland for sheep, corresponding to 0.792 mg. and 0.945 mg. per gram of dried gland, respectively.

TABLE 4.—NORMAL-EARLY GLANDULAR HYPERPLASIA

Animal.	No. Cases.	Iodin per gm. dried.			Iodin per gm. fresh.		
		E.	M.	A.	E.	M.	A.
Sheep	1	.....	.....	0.677	.....	.....	0.176
Dog	7	1.296			0.318		
		0.483	0.815	0.879	0.018	0.153	0.174
Hog	1	.....	.....	1.230	.....	.....	0.337
Ox	7	2.676			0.726		
		2.000	2.307	2.317	0.482	0.653	0.628

Table 4, together with Table 3, deals with the most important thyroid changes concerned in the production of goiter. It is seen that the highest extremes of iodine content are invariably below the lowest extreme

3. Secondary in the sense that this is the second time these glands have undergone active hyperplasia.

iodin contents of normal glands. This is even more evident with the means and averages. The table also shows that there is considerable difference between the average iodine content of sheep's thyroids and that of oxen thyroids, just as was seen to be true of the normal glands of these animals. It suggests, as was stated under Table 1, that oxen normally have more iodine and less thyroid per kilogram of body weight. In accordance with this, hyperplastic changes are manifest with an iodine content nearly four times that of the sheep's thyroids. But the most striking thing, just as in the colloid-early glands, is the great drop in iodine content from the normal, which must occur before hyperplastic changes are observed. The table shows that the lower limit of iodine necessary for the maintenance of normal structure is somewhat in excess of 0.176 mg. per gram of fresh gland for sheep, 0.174 for dogs, 0.337 for hogs and 0.628 for cattle, or 0.677, 0.879, 1.230, 2.317 mg. per gram of dried gland, respectively.

TABLE 5.—EARLY GLANDULAR HYPERPLASIA

Animal.	No. Cases.	Iodin per gm. dried.			Iodin per gm. fresh.		
		E.	M.	A.	E.	M.	A.
Sheep	0	.....	.....	.....	.....	.....	.....
Dog	9	1.028			0.235		
		0.243	0.654	0.625	0.063	0.113	0.139
Hog	2	1.158			0.291		
		1.046	.....	1.102	0.279	....	0.285
Ox	3	2.186			0.615		
		1.123	1.630	1.646	0.314	0.456	0.462

In the group of early glandular hyperplasia the iodine contents are still further lowered and the drop is practically the same in all four animals. The ox thyroids still show higher iodine contents than the other animals' glands for the same degree of thyroid hyperplasia as was also noted in the normal and normal-early glands.

TABLE 6.—EARLY-MODERATE GLANDULAR HYPERPLASIA

Animal.	No. Cases.	Iodin per gm. dried.			Iodin per gm. fresh.		
		E.	M.	A.	E.	M.	A.
Sheep	1	.....	.....	0.548	.....	.....	0.131
Dog	1	.....	.....	0.262	.....	.....	0.082
		0.846			0.241		
Hog	3	0.769	0.769	0.795	0.198	0.233	0.224
		1.030			0.252		
Ox	5	0.969	1.000	1.000	0.205	0.222	0.226

In the table of early-moderate glandular hyperplasia are collected those glands which histologically show a degree of epithelial proliferation (hyperplasia) too pronounced to be considered as early glandular hyperplasia and not sufficient to be classed as moderate glandular hyperplasia. As regards their iodine contents, the upper extremes are in every instance lower than the lower extremes of the preceding group (early glandular hyperplasia). So also the average iodine contents are about as much below those of the group of early glandular hyperplasias as the early glandular hyperplasias are below the group of normal-early glandular hyperplasias.

TABLE 7.—MODERATE GLANDULAR HYPERPLASIA

Animal.	No. Cases.	Iodin per gm. dried.			Iodin per gm. fresh.		
		E.	M.	A.	E.	M.	A.
Sheep	1	.....	.....	0.400	.....	.....	0.091
		0.854			0.136		
Dog	9	0.345	0.368		0.076	0.078	
		0.101			0.026		
Hog	0	.....	.....	.....	.....	.....	.....
Ox	0	.....	.....	.....	.....	.....	.....

There being no glands from hogs or oxen and but one from the sheep series that histologically belonged to the group of moderate glandular hyperplasia, comparisons are impossible. The average iodine contents of the cases recorded are as usual below those of the preceding group.

TABLE 8.—MODERATE-MARKED GLANDULAR HYPERPLASIA

Animal.	No. Cases.	Iodin per gm. dried.			Iodin per gm. fresh.		
		E.	M.	A.	E.	M.	A.
Sheep	5	0.092	0.024	0.031	0.014	0.003	0.004
		0.000			0.000		
		0.660			0.109		
Dog	9	0.231	0.283		0.042	0.055	
		0.058			0.011		
Hog	0	.....	.....	.....	.....	.....	.....
Ox	0	.....	.....	.....	.....	.....	.....

In the group of moderate-marked hyperplasia also there are but two animals represented. The extremes of iodine content in the dog thyroids are widely separated. As has already been pointed out, it is impossible to tell from the histology alone whether a given gland is undergoing further hyperplasia or is reverting to a lesser degree, in which latter event the iodine would be higher. Another factor must also be considered, that is, that dogs live under far less constant conditions than sheep and

oxen. It will be shown later that the more constant the conditions of life the more constant are the iodine contents. The averages show the same drop in the iodine contents proportional to the degree of increase of the hyperplasia.

TABLE 9.—MARKED GLANDULAR HYPERPLASIA

Animal.	No. Cases.	Iodin per gm. dried.			Iodin per gm. fresh.		
		E.	M.	A.	E.	M.	A.
Sheep	6	0.036			0.006		
		0.000	0.000	0.006	0.000	0.000	0.001
Dog	18	0.640			0.123		
		0.008	0.073	0.114	0.002	0.014	0.023
Hog	0	.....	.....	.....	.....	.....	.....
Ox	5	0.270			0.062		
		0.077	0.215	0.189	0.016	0.042	0.041

Table 9 includes those glands having the most marked degree of thyroid hyperplasia and in consequence the lowest iodine contents. The only glands in which no estimable amount of iodine was found were in sheep, although, histologically, the degree of hyperplasia was no greater than in other glands which showed traces of iodine. The average iodine contents are all lower than the averages of the preceding group. So also the extremes are lower except in dogs' thyroids, in which the same wide variations are noted as in Table 8. Our explanation is the same.

SUMMARY AND DISCUSSION

Table 10, showing average iodine contents, has been introduced both as a summary and to emphasize the relation which exists between the iodine contents and the corresponding histologic structure.

TABLE 10.—AVERAGES

Anatomic Groups.	Sheep. Iodin per gm.		Dog. Iodin per gm.		Hog. Iodin per gm.		Ox. Iodin per gm.	
	Dried.	Fresh.	Dried.	Fresh.	Dried.	Fresh.	Dried.	Fresh.
Normal	2.467	0.686	3.322	0.777	2.515	0.884	3.461	1.117
Normal-early	0.677	0.176	0.879	0.174	1.230	0.337	2.317	0.628
Early .....	.....	.....	0.625	0.139	1.102	0.285	1.646	0.462
Early-moderate ..	0.548	0.131	0.262	0.082	0.795	0.224	1.000	0.226
Moderate	0.400	0.091	0.368	0.078	.....	.....	.....	.....
Moderate-marked.	0.031	0.004	0.283	0.055	.....	.....	.....	.....
Marked	0.006	0.001	0.114	0.023	.....	.....	0.189	0.041
Colloid	2.996	0.818	1.985	0.459	2.353	0.681	.....	.....
Colloid-early	0.792	0.206	0.945	0.217	.....	.....	.....	.....

Since colloid glands differ from normal glands essentially in that they have undergone active hyperplasia, two series (1), normal, and (2), colloid, must be recognized. Taking up the normal series, which is

practically complete in that it contains all the gradations of hyperplasia, it is seen that in all four species of animals the strictly normal glands have the highest iodine contents and those with marked glandular hyperplasia the lowest. The intervening groups show progressive decline, depending on the extent of the hyperplasia. The greatest drop in iodine content between any two successive groups occurs between the normal and the normal-early glandular hyperplasias, that is, those glands showing the earliest histologic deviation from normal. This great drop occurs with all four species and is similar in nature to the drop which occurs between the pure colloid glands and the colloid-early glandular hyperplasias. As has been said, this drop suggests that there is a minimum iodine content necessary for the maintenance of the normal or colloid state of the gland, and, since the amount of iodine present in normal or colloid glands is, as a rule, far in excess of this minimum, it is possible that this difference represents the reserve or factor of safety.

Certain details of this relation of iodine to the structure of the glands are more clearly shown in the full Tables 11, 12 and 13. Here it will be seen that by arranging the iodine contents in series from minimum to maximum, the glands are also arranged in series according to their histology, their colloid contents and their weights. In other words, the weights of the glands vary directly with the degree of hyperplasia and inversely with the percentage iodine content; the stainable colloid varies inversely with the degree of hyperplasia and directly with the iodine content, and the degree of hyperplasia varies inversely with the iodine contents (the normal and colloid series being, of course, considered separately).

It is also noticed that within any anatomic group there is considerable variation in the iodine contents. This is for the greater part due to the arbitrary anatomic groups, since the glands show histologic variations corresponding to the iodine variations, but not sufficient to warrant separate grouping. In other words, the arbitrary groups but imperfectly represent the gradations which the complete tables fully picture.

It may also be added that no special stress is laid on the actual figures of the iodine determinations, but only their relative importance as a series has been considered. Other observers with other methods may obtain different figures, but the relation between the iodine content and the gland structures, we believe, will always be found constant.

Passing now to the colloid series, it will be seen that only two groups of colloid glands have been observed: (1) pure colloids, (2) colloid-early glandular hyperplasia. This is noteworthy because in our human collection (to be reported), using the same anatomic classification and

TABLE 11.—PIGS' THYROIDS

Case No.	Age. Sex.	Condition.	Locality.	Weight of Gland.	Color.	Consistency.	Colloid.	Normal.	Colloid.	Normal-Early.	Colloid-Early.	Early.	Early-Moderate.	Moderate.	Moderate-Marked.	Marked.	Iodin per gm. Dried.	Iodin per gm. Fresh.
P. 2.	10 mos. M.*	Good	Iowa.....	?	Fleshy red	Moderately soft.	Reduced.	..	..	..	..	+	..	..	..	..	0.769	0.198
P. 24.	10 mos. M.	"	"	?	"	Moderately soft.	"	..	..	..	..	+	..	..	..	..	0.769	0.233
P. 21.	10 mos. F.	"	"	?	"	Moderately soft.	"	..	..	..	..	+	..	..	..	..	0.846	0.241
P. 17.	10 mos. M.	"	"	?	Yellow-red, transluc.	Moderate....	Visible	..	..	..	+	..	..	..	..	..	1.046	0.279
P. 7.	10 mos. F.	"	"	?	"	"	"	..	..	..	..	+	..	..	..	..	1.158	0.291
P. 16.	9 mos. F.	"	"	?	Clear yellow-red	Firm	"	..	..	+	..	..	..	..	..	..	1.230	0.337
P. 6.	10 mos. M.	"	"	?	"	"	Normal.	+	..	..	..	..	..	..	..	..	1.538	0.425
P. 18.	10 mos. M.	"	"	?	"	"	"	+	..	..	..	..	..	..	..	..	1.538	0.553
P. 5.	10 mos. F.	"	"	?	"	"	"	+	..	..	..	..	..	..	..	..	1.938	0.523
P. 19.	11 mos. M.	"	"	?	"	"	"	+	..	..	..	..	..	..	..	..	1.938	0.557
P. 25.	9 mos. F.	"	"	?	"	"	"	+	..	..	..	..	..	..	..	..	1.938	0.596
P. 12.	10 mos. F.	"	"	?	"	"	"	+	..	..	..	..	..	..	..	..	1.938	0.599
P. 20.	10 mos. M.	"	"	?	"	"	"	+	..	..	..	..	..	..	..	..	1.938	0.603
P. 4.	10 mos. F.	"	"	?	"	"	"	+	..	..	..	..	..	..	..	..	1.984	0.774
P. 26.	10 mos. F.	"	"	?	"	"	"	+	..	..	..	..	..	..	..	..	1.997	0.601
P. 10.	10 mos. M.	"	"	?	"	"	"	+	..	..	..	..	..	..	..	..	2.307	0.783
P. 23.	8 mos. M.	"	"	?	"	"	"	+	..	..	..	..	..	..	..	..	2.517	0.587
P. 14.	8 mos. M.	"	"	?	"	"	"	+	..	..	..	..	..	..	..	..	2.615	1.071
P. 11.	8 mos. F.	"	"	?	"	"	"	+	..	..	..	..	..	..	..	..	2.768	0.905
P. 9.	8 mos. M.	"	"	?	"	"	"	+	..	..	..	..	..	..	..	..	2.768	0.940
P. 8.	2 yrs. F.	"	?	?	Pale yellow, transluc.	"	"	+	..	..	..	..	..	..	..	..	2.768	0.805
P. 1.	10 mos. M.	"	Iowa	?	Clear yellow-red	"	"	+	..	..	..	..	..	..	..	..	3.230	1.121
P. 15.	8 mos. M.	"	"	?	"	"	"	+	..	..	..	..	..	..	..	..	3.691	1.220
P. 3.	10 mos. M.	"	"	?	"	"	"	+	..	..	..	..	..	..	..	..	3.691	1.456
P. 22.	10 mos. F.	"	"	?	"	"	"	+	..	..	..	..	..	..	..	..	3.728	1.140
P. 13.	8 mos. F.	"	"	?	"	"	"	+	..	..	..	..	..	..	..	..	4.154	1.298

*Age estimated by butchers.

TABLE 12.—CATTLE THYROIDS

General.				Gross.				Microscopical.							Chemical.				
Case No.	Age.	Sex.	Condition.	Locality.	Weight of Glands in gms.	Color.	Consistency.	Colloid.	Normal.	Colloid.	Normal-Early.	Colloid-Early.	Early.	Early-Moderate.	Moderate.	Moderate-Marked.	Marked.	Iodin, per gm., Dried.	Iodin, per gm., Fresh.
C. 34.	Young steer,*	Good..		Northern Ohio.	41	Opaque, pale brown.	Soft.	Absent ..									+	0.077	0.016
C. 36.	"	"	"	Northern Ohio.	53	Very pale brown....	"	" ..									+	0.154	0.031
C. 29.	Calf, female.	Poor..		Michigan..	370	" " "	"	" ..									+	0.215	0.042
C. 30.	Young steer.	Good..		Northern Ohio.	39	" " "	"	" ..									+	0.231	0.052
C. 35.	"	"	"	Northern Ohio.	13	Dark brown-red....	Moderate. .	Visible ..									+	0.270	0.062
C. 40.	"	"	"	Northern Ohio.	27	Brown red.....	"	" ..					+					0.969	0.205
C. 33.	"	"	"	Northern Ohio.	17	Dark brown-red....	"	" ..					+					0.969	0.205
C. 31.	"	"	"	Northern Ohio.	17	" " "	"	" ..					+					1.030	0.222
C. 37.	"	"	"	Northern Ohio.	16	Translucent, brown-red.	"	" ..					+					1.000	0.248
C. 38.	"	"	"	Northern Ohio.	19	Pale brown, translucent.	Firm	" ..					+					1.030	0.252
C. 39.	"	"	"	Northern Ohio.	16	Pale brown, translucent.	"	Normal. .					+					1.123	0.314
C. 32.	"	"	"	Northern Ohio.	13	Brown red, translucent.	"	" ..					+					1.630	0.456
C. 65.	"	"	"	Northern Ohio.	12	Brown red, translucent.	"	" ..					+					2.153	0.482
C. 46.	"	"	"	Texas.....	12	Dark brown-red, translucent.	"	" ..					+					2.000	0.585
C. 51.	"	"	"	"	13	Pale brown-red, translucent.	"	" ..					+					2.186	0.615
C. 45.	"	"	"	"	13	Very pale yellow brown, translu.	"	" ..					+					2.076	0.617
C. 48.	"	"	"	"	12	Pale yellow brown, translucent.	"	" ..					+					2.307	0.653
C. 64.	"	"	"	Northern Ohio.	13	Pale yellow brown, translucent.	"	" ..					+					2.615	0.664
C. 41.	Young bull..	"		Texas.....	11.5	Pale yellow brown, translucent.	"	" ..					+					2.676	0.666
C. 42.	Young steer.	"		"	12	Pale yellow brown, translucent.	"	" ..					+					2.384	0.726
C. 47.	"	"	"	"	11	Yellow-brown, translucent.	"	" ..					+					2.730	0.892
C. 44.	"	"	"	"	15	Pale brown, translucent.	"	" ..					+					2.922	0.901
C. 43.	"	"	"	"	11	Pale brown, translucent.	"	" ..					+					2.937	0.952
C. 49.	"	"	"	"	11	Pale brown, translucent.	"	" ..					+					3.107	0.988
C. 52.	"	"	"	"	12	Brown red, translucent.	"	" ..					+					3.091	0.992
C. 57.	"	"	"	"	12	Pale yellow, translucent.	"	" ..					+					3.254	1.020
C. 56.	"	"	"	"	11	Pale yellow, translucent.	"	" ..					+					3.537	1.039
C. 63.	"	"	"	"	11	Pale yellow, translucent.	"	" ..					+					3.230	1.040
C. 55.	"	"	"	"	12	Pale yellow, translucent.	"	" ..					+					3.230	1.069
C. 50.	"	"	"	"	14	Pale yellow, translucent.	"	" ..					+					3.384	1.133
C. 62.	"	"	"	"	12	Pale yellow, translucent.	"	" ..					+					3.630	1.152
C. 61.	"	"	"	"	12	Pale yellow, translucent.	"	" ..					+					3.630	1.161
C. 60.	"	"	"	"	11	Pale yellow, translucent.	"	" ..					+					3.230	1.208
C. 58.	"	"	"	"	12	Pale yellow, translucent.	"	" ..					+					3.999	1.215
C. 53.	"	"	"	"	13	Pale yellow, translucent.	"	" ..					+					3.999	1.292
C. 54.	"	"	"	"	11	Pale yellow, translucent.	"	" ..					+					4.153	1.347
C. 59.	"	"	"	"	11	Pale yellow, translucent.	"	" ..					+					4.768	1.592

*i.e. 3 to 5 yrs. as estimated by cattlemen.

†General term among cattlemen, meaning any part of Great Plains.

TABLE 13.—SHEEP THYROIDS

General.				Gross.				Microscopical.							Chemical.			
Case No.	Age. Sex.	Condition.	Locality.	Weight in gms.	Color.	Consistency.	Colloid.	Normal.	Colloid.	Normal-Early.	Colloid-Early.	Early.	Early-Moderate.	Moderate.	Moderate-Marked.	Marked.	Iodin, per gm., Dried.	Iodin, per gm., Fresh.
S. 33.	F 8 mos...	Good..	Seville, Ohio.	95.0	Gray red, translucent.	Soft.	Visible...	..	..	..	..	..	..	..	..	+	0.000	0.000
S. 37.	M. 10 mos.	" ..	Seville, Ohio.	115.0	Gray red, opaque...	"	None	..	..	..	..	..	..	..	..	+	0.000	0.000
S. 39.	M. 9 mos...	" ..	Seville, Ohio.	85.0	" " " ..	"	"	..	..	..	..	..	..	..	..	+	0.000	0.000
S. 45.	M. 8 mos...	" ..	Seville, Ohio.	55.0	" " " ..	"	"	..	..	..	..	..	..	..	..	+	0.000	0.000
S. 20.	? 8 mos...	" ..	?	110.0	" " " ..	"	"	..	..	..	..	..	..	..	..	+	0.000	0.000
S. 36.	M. 9 mos...	" ..	Seville, Ohio.	120.0	Gray, translucent...	"	Visible...	..	..	..	..	..	..	..	..	+	0.000	0.000
S. 38.	M. 10 mos.	" ..	Seville, Ohio.	130.0	" " " ..	"	"	..	..	..	..	..	..	..	..	+	0.000	0.000
S. 34.	F. 9 mos...	" ..	Seville, Ohio.	98.0	" " " ..	"	"	..	..	..	..	..	..	..	..	+	0.024	0.003
S. 35.	F. 9 mos...	" ..	Seville, Ohio.	110.0	" " " ..	"	"	..	..	..	..	..	..	..	..	+	0.040	0.005
S. 59.	? 1 yr....	" ..	?	6.0	Opaque, red, granular.	"	None.....	..	..	..	..	..	..	..	..	+	0.036	0.006
S. 21.	M. 1 yr....	" ..	?	64.0	Opaque, red, granular.	"	Visible...	..	..	..	..	..	..	..	..	+	0.092	0.014
S. 49.	F. 8 mos...	" ..	?	48.0	Opaque, red, granular.	"	"	..	..	..	..	..	..	..	..	+	0.400	0.091
S. 47.	M. 9 mos...	" ..	?	6.0	Red-gray, translucent.	Moderate...	"	..	..	..	..	..	..	..	..	+	0.548	0.131
S. 32.	F. 4 yrs.	Fair..	?	370.0	Red-yellow, translucent.	Firm	Normal..	..	..	+	..	..	..	..	..	..	0.461	0.138
S. 43.	F. 5 yrs.	" ..	?	15.0	Red-yellow, translucent.	"	"	..	..	+	..	..	..	..	..	..	0.677	0.176
S. 51.	M. 9 mos...	Good..	?	18.0	Red-yellow, translucent.	"	Visible...	..	..	+	..	..	..	..	..	..	0.923	0.201
S. 50.	M. 9 mos...	" ..	?	16.0	Red-yellow, translucent.	"	"	..	..	+	..	..	..	..	..	..	0.784	0.202
S. 46.	F. 5 yrs.	Fair..	?	25.0	Clear yellow, translucent.	"	Normal..	..	..	+	..	..	..	..	..	..	1.000	0.282
S. 52.	? 1 yr....	Good..	?	5.9	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	1.260	0.308
S. 53.	? 1 yr....	" ..	?	6.7	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	1.247	0.313
S. 55.	? 1 yr....	" ..	?	6.5	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	1.425	0.365
S. 48.	F. 9 mos...	Fair..	?	5.9	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	1.602	0.405
S. 63.	F. 3 yrs...	Good..	?	8.0	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	1.615	0.430
S. 60a	M. 2 yrs...	" ..	?	58.0	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	1.769	0.455
S. 58.	? 1 yr....	" ..	?	4.5	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	1.812	0.468
S. 60.	F. 3 yrs.	Fair..	Northern Ohio.	8.0	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	2.153	0.564
S. 61.	F. 3 yrs.	" ..	Northern Ohio.	8.5	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	2.288	0.582
S. 62.	F. 4 yrs.	" ..	Northern Ohio.	8.0	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	2.153	0.608
S. 65.	F. 4 yrs.	" ..	Northern Ohio.	8.5	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	2.392	0.694
S. 44.	F. 4 yrs.	" ..	?	6.0	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	2.250	0.727
S. 67.	? 1 yr....	" ..	?	7.5	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	2.644	0.735
S. 57.	? 1 yr....	" ..	?	5.4	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	3.292	0.823
S. 70.	F. 4 yrs.	" ..	Northern Ohio.	7.0	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	3.054	0.861
S. 69.	F. 3 yrs.	" ..	Northern Ohio.	8.0	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	3.058	0.872
S. 66.	F. 3 yrs.	" ..	Northern Ohio.	7.5	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	3.150	0.872
S. 54.	? 1 yr....	Good..	?	6.55	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	2.500	0.890
S. 64.	? 1 yr....	" ..	Northern Ohio.	8.0	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	3.691	0.974
S. 19.	M. 2 yrs...	Excellent.	?	52.0	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	3.529	1.027
S. 56.	M. 1 yr....	Good..	?	6.4	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	4.368	1.200
S. 68.	M. 10 mos.	" ..	Northern Ohio.	7.5	Clear yellow, translucent.	"	" ..	+	..	..	..	..	..	..	..	..	4.614	1.318

methods, the colloid series will contain sufficient gradations of the hyperplasias to parallel the normal series throughout and will be discussed with equal emphasis.

These two groups of colloid glands suffice, however, to illustrate, first, the fact that pure colloid glands of the different animals have iodine contents very closely approaching those of normal glands, and, second, that colloid-early glandular hyperplasias have iodine contents similarly close to those with normal-early glandular hyperplasias. We believe that if all the conditions (diet, etc.) could be strictly controlled the iodine content of colloid glands would absolutely parallel those of normal glands and that a like parallelism would be seen throughout the gradations of hyperplasia of both the normal and colloid series.

The probable reasons why we rarely obtain colloid glands in sheep, cattle and hogs are (1) that they are killed at an age when the natural occurrence of colloid glands is rare, and (2) that the conditions of life (as regards habits, food and locality) are more constant than obtain for man or dogs.

So striking a uniformity in the anatomic changes for widely different animals can not be without significance. It suggests that the etiologic factor or factors in the production of thyroid hyperplasia (goiter) are probably the same in all these animals. The constant relation between structure and iodine content suggests that iodine is a common factor in all these animals.

It seems fair to infer from this comparative study of anatomic structure and iodine content that iodine is a very important factor, acting in the same direction and manner in all classes of animals in which hyperplasias (goiterous changes) are observed, and that, therefore, for a general study of goiter, any of the animals mentioned may be used as a basis, and the results be applicable to man.

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