

The Hæmolytic Lipoids of Degenerating Fibroids with Special Reference to Red Degeneration.*

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THE study of red degeneration in uterine fibroids has recently received considerable stimulus from the interesting report on four cases presented to this Society in January of last year by Lorrain Smith and Fletcher Shaw.¹

The results of the examination of four specimens of the condition which it has been my privilege within the past eighteen months to conduct, together with some conclusions following on an investigation of the lipoid content of red and other degenerating fibroids will therefore, I hope, prove of interest.

The cases are as follows:—

No. 1 (Dr. WALLACE'S CASE).

The patient was 43 years old, and had not been pregnant for 16 $\frac{3}{4}$ years. The symptoms were chronic pain and discomfort. There was no rise of temperature before operation.

Macroscopical appearances. The fibroid was a large interstitial one, measuring 15 by 20 cms., and was situated in the posterior wall; the surface was smooth and the consistence uniformly rather soft, but not markedly so; the cut surfaces in all directions showed a smooth almost unwhorled appearance coloured a definite red; there were no black spots visible anywhere; the colour was not the mahogany red sometimes seen, but was quite marked and resembled very under-done meat more than anything; it varied but little in intensity from place to place; there was, however, no area where the colour was *not* red; the capsule was not congested.

The tumour was sterile, both *æro*bically (nasgar, ascitic fluid broth, milk and bile) and *anæro*bically (milk and bile).

Microscopical appearances. Sections show very irregular nuclear staining; in some areas little or none is seen, while in others nuclear staining is well preserved; the structure as a whole is faintly granular with a little shrinkage of the fibres in places and some hyaline change in others; picric acid is well taken up; the endothelium of the vessels is frequently lost, and where this is so no rounded corpuscles are seen, but only *débris*.

* Read at the North of England Obstetrical and Gynæcological Society on April 15 1910.

Weigert's fibrin stain is positive in many of the smaller vessels; in the majority, however, no such change can be made out.

Free iron cannot be demonstrated.

Sudan III. gives a well-marked golden-red staining; the collections of fat tend to run in the direction of the fibres; there are also a few localized accumulations; the positive colouring is well developed in the walls of the vessels.

No. 2 (Dr. GEMMELL'S CASE).

The patient was sixty years old, and had never been pregnant; the symptoms included dysuria and chronic abdominal pain; the general health was good and the menopause had occurred 12 years previously.

Macroscopical appearances. The tumour, which was removed with the uterus, was interstitial, rounded, hard and even. It weighed 1,008 grammes, and was as big as a full term foetal head; the uterus and the tumour were found impacted in the pelvis at operation; section showed a dark red hue over the half of the tumour next the endometrium, with some softening; the rest of it was hard and white.

Microscopical appearances. I had only the opportunity of examining a small piece of this specimen at the periphery of the red portion, so the findings are probably slighter than if pieces had been sectioned more deeply in the red area. The uncoloured area shows ordinary fibroid tissue with at most a few streaks of simple hyaline degeneration. As the red area is entered some patchy loss of nuclear staining becomes apparent; many areas, however, stain relatively well; where nuclear staining is defective, the fibres also show degenerative changes of a rather granular nature with occasionally more hyaline streaks; picric acid is taken up well in these areas; the vessels are far from numerous, and occasionally show some disorganization in their walls with débris in the lumina.

Weigert's fibrin stain is positive in a few small vessels.

No free iron can be detected.

Sudan III. shows in the reddened area large collections of fat, from their patchy distribution readily visible to the naked eye. A few small collections can be seen along the vessels in the uncoloured part.

Examination for organisms with Leishman's and Gram's stains is negative.

No. 3 (Dr. GEMMELL'S CASE).

The patient was 36 years old, and had not been pregnant before. A history was given of pain for several years, amenorrhœa for 17 weeks, with the sudden development of acute pain and swelling in the side two weeks before coming under observation, accompanied by a "chill" and a feeling of general upset. There was no rise of temperature before operation.

Macroscopical appearances. The specimen consisted of a pregnant uterus containing a five months' foetus, and studded with subperitoneal and interstitial fibroids, varying in size from a cricket ball to a pea; the largest of these (*a*) arose low down on the left side, and was impacted in the pelvis; on section the cut surface had a dirty washleather appearance, a firm consistence, and no trace of red colour. Four of the smaller fibroids (*b*), varying in size from a golf ball to a pigeon's egg, and both subperitoneal and interstitial, showed red degeneration of a very marked type; the colour was like raw beef, the consistence firm, and there were no areas of softening; the capsules showed no congestion and the colour was universal and homogeneous. A few of the still smaller tumours (*c*) showed streaks of red running through pale and firm fibroids; while the very smallest were quite unaffected.

Microscopical appearances. (*a*) There is almost complete absence of nuclear staining; a little persists along the line of the vessels, of which a fair number can be seen; the degenerated bundles are hyaline with a certain amount of granular change in addition, and they take up picric acid well.

Weigert's fibrin stain is positive in several of the smaller vessels, but the majority remain free.

Free iron cannot be detected.

Sudan III. is markedly positive with patches of golden red throughout.

(*b*) The description under (*a*) applies in every detail.

(*c*) There is considerable loss of nuclear staining in the reddened areas with some fibrin deposit even in relatively large vessels and a little extravasation of corpuscles into the substance of the tumour.

Representative pieces from (*a*) and (*b*) were tested both aerobically and anaerobically, as above, and found to be sterile.

No. 4 (Prof. J. A. C. KYNOCH'S CASE).

The patient was 34 years old, and had never been pregnant; pain was not an outstanding feature, and operation was advocated for gradually increasing menorrhagia; the temperature was not taken before operation, as nothing pointed to a rise.

Macroscopical appearances. The tumour was interstitial, and measured about 19 cms. across; the red colour was universal and of an almost mahogany hue; the specimen was not cut across till after fixation, but the capsular veins then strongly suggested thrombosis: the consistence was firm and there were no areas of softening.

Microscopical appearances. Nuclear staining is irregular and sparse; the fibres show the usual combination of hyaline with granular change; there is great engorgement of the veins in and immediately within the capsule, with considerable extravasation of blood into the tissues in this region. (Herein this case differs from

the three preceding, and resembles the more unusual cases described by Fairbairn² in his monograph.) The walls of the vessels in these peripheral parts are intact. More deeply, this vascularization ceases, the degeneration of the bundles becomes more marked and the appearance conforms to the more usual type of red fibroid.

Weigert's fibrin stain is almost completely negative; the capsular veins which one confidently expected to find filled with fibrin, show none at all, and in the tumour itself only a very occasional small vessel shows it; one or two of the vessels, at the edge of the engorged area, present an appearance suggesting the commencement of agglutinative thrombi.

No free iron can be made out.

Sudan III. shows a well-distributed, but slight, deposit of fat; the specimen, however, had passed, in course of preservation, through spirit, so probably part of the fat had been dissolved out.

Sections stained with Leishman's and Gram's stains are negative.

Before proceeding to discuss the many features of interest in these four cases, it will be advisable to detail the result of an investigation into the total lipid content of four degenerating fibroids. The hæmolytic action of many lipoids is, of course, a well recognized one; but, so far as I can ascertain, no suggestion of their relation to the phenomenon of laking of the blood in fibroids has been made.

The method adopted was as follows:—A given weight of finely minced fibroid was mixed with a sufficiency of gypsum to ensure dryness. The set cake was ground in a mortar to a powder, which was thoroughly extracted with ether, by agitation for 24 hours and repeated washings. The residue was acidulated, evaporated on a water-bath and again extracted with ether. By this means certain phosphatides, which by combination with proteid are insoluble in ether, are liberated. No chemical analysis was attempted, but the action on red corpuscles was investigated. In each case the extracted lipid was yellow, fairly firm at room temperature, and had a melting point above 36·5°C.

CASE 5.

Macroscopical appearances. The fibroid was interstitial, and weighed 640 grammes; the surface was smooth and the consistence firm; the cut surface was pale and slightly yellow with a tint of brown towards the centre; the general appearance was very homogeneous with little of the usual whorling; there were no cysts and no soft areas; a few of the larger vessels stood out as yellow circles; no red colour was apparent at any point.

Sterility was confirmed.

Microscopical appearances. Nuclear staining is very defective, many areas showing practically none; the fibres are granular and stain brightly with picric acid; the strands of connective-tissue.

however, still absorb a little fuchsin; the outline of the vessels is indefinite and endothelium is seen in only a very few; no corpuscles are seen in any of the lumina, but débris is present in considerable quantity.

Weigert's fibrin stain is negative.

Sudan III. shows very extensive golden-red staining throughout. It must be remembered that Sudan III. is a satisfactory stain for fats only and not for soaps. The sunset-red of the former is very distinct, but the yellowish-pink of the latter too much resembles the general tissue staining. The silver method of Klotz³ for picking out the calcium phosphate of a later stage of fatty change has not in my hands given very clear results, except in the advanced cases. I have not, however, tried his plan of first converting the phosphate into chromate. Distinct staining, then, by Sudan III. is no criterion of the total lipoid present.

The total lipoid extracted from 20 grammes of fibroid by the method given above was 0·346 grammes.

CASE 1 (Dr. WALLACE'S CASE) described above.

The total lipoid extracted from 20 grammes was 0·269 grammes.

CASE 6.

Macroscopical appearances. This was an interstitial fibroid, weighing 200 grammes; the surface was slightly lobulated, and the consistence before opening was firm. On cutting across it there was seen to be some separation of the fibres by œdema, and a little clear fluid could be squeezed out; the cut surface was dull white and scarcely so whorled as an undegenerated fibroid.

Sterility was confirmed.

Microscopical appearances. There is a little separation of fibres by œdema—the fluid accumulating in lacunæ with no tendency to form definite cysts; the vessels are numerous and full of formed corpuscles.

With Sudan III. very small points of fatty deposit are seen in places—most marked around the lacunæ.

The total lipoid extracted from 20 grammes of fibroid was 0·149 grammes.

CASE 7.

Macroscopical appearances. This was a very large interstitial fibroid with considerable lobulation on the surface, and firm consistence before being opened; on cutting into it, clear fluid readily flowed away; after being chopped up and allowed to drain for four hours the weight was reduced from 1,180 grammes to 980 grammes; the fluid did not clot on standing. The bundles of tissue between the spaces were hard and white vascularity was good throughout, and its sterility was confirmed.

Microscopical appearances. Staining is good except where the oedematous infiltration is very marked; there is distinct hyaline transformation of the connective-tissue in places; the muscle fibres have the coarse appearance so often associated with oedematous degeneration; the vessels are distended with blood.

Sudan III. shows up small deposits running along the line of the fibres and spread well over; some larger collections are seen in places; there is distinctly more as a whole than in Case 6.

The total lipid extracted from 20 grammes of fibroid was 0.224 grammes.

A general comparison of the amounts of lipid extracted from these four fibroids is of interest. It will be noted that the fibroid showing most was No. 5, where nearly all nuclear staining had disappeared. On the other hand, No. 6, in which the degeneration was slight, presented a relatively large amount—almost half of No. 5. Co-relating with this the results of Sudan III. staining, it would appear that in Nos. 5 and 1 the lipid was largely fatty, and in Nos. 6 and 7 soapy.

Now, as to the hæmolytic property of these liquids. They all showed it to a marked degree. One per cent. emulsions were made by grinding the material in the necessary amount of normal saline in an agate mortar. This rough emulsion was then placed in an incubator, and, after an hour, violently shaken and rapidly cooled to preserve the emulsion as fine as possible. Varying quantities were added to 3 per cent. or 5 per cent. suspensions of pooled corpuscles in normal saline. The total quantities were then equalized, and the tubes placed in an incubator at 36.5°C., and thereafter in an ice-chest overnight. In Chart 1 is given the results obtained with a 3 per cent. suspension.

The most interesting point about this hæmolytic action is the peculiar brown transformation with bleaching of the colour which occurs when lipid is present in excess of that required for complete hæmolysis. With lipid sufficient for complete hæmolysis the fluid is coloured a bright red throughout. With more lipid present a brownish tint supervenes, while with still more lipid, a brownish-black deposit appears and the supernatant fluid becomes absolutely clear without a trace of red colour.* This phenomenon was present in every case. Prof. Ben. Moore has suggested to me that it is due to hydrolysis of the lipid and the formation of free oleic acid, in the presence of which it is invariably found.

The action of blood serum on this process was next investigated, and, as always with these lipoids, it was found to have a strongly inhibitory effect.* This is illustrated in Chart 2, which is typical of all. This inhibitory action is neither specific nor vital. Stale horse

* Demonstrations *in vitro* were given.

serum possesses it equally with human serum. Heating fresh serum to 56°C. for 30 minutes does not effect the result.

Citrated plasma behaved exactly as serum.

Klotz describes the formation in the tissues of compounds of albumen and soaps which are much less soluble than the original sodium and potassium soaps. Probably this is the explanation of the restraining action.

What conclusions, then, can be drawn from these experiments?

Firstly, it is clear that in degenerating fibroids there is present an actively hæmolytic element which is held in check by the presence of the blood plasma. This accumulation of lipid may be large without hæmolysis taking place. A balance is held between the two, and only when lipid accumulates beyond the amount that the blood can inactivate or when the blood supply is reduced in proportion can this potentiality become active.

Secondly, if the hæmolytic process occurring in fibroids is of this lipoidal character it is equally clear that a continuance of the process may lead to loss of the red colour with substitution of a greyish or greyish-brown tint.

If we now regard red degeneration with these possibilities in view, several suggestive points will readily occur to mind.

It will be convenient to consider these possibilities under the headings of:—

- (1) The essential nature of the process.
- (2) The clinical course associated with red degeneration.
- (3) The question of thrombosis.
- (4) Classification.

(1) The essential nature of the process. The degeneration is obviously due to some *local* condition existing in the fibroid. In Bland-Sutton's words, "It is curious to see a gravid uterus containing four or five fibroids the size of potatoes, and only one exhibiting this remarkable degeneration." No one, I take it, now doubts that the actual condition produced is a real laking of the blood in the tissue of the tumour. Pieces from Cases 1 and 2, which were apparently mild in type, placed in normal saline, which was occasionally gently agitated, lost most of the red colour within 24 hours. The tint remaining after this immersion was more grey than red, but the depths of the piece remained red. The other two cases did not so lose their colour. Evidently the pigment becomes fixed in the tissues. Of the nature of this pigment I can say nothing. The oxyhæmoglobin bands can readily be detected in it, as Taylor⁶ also has demonstrated. But free iron can not be shown in the tissues.

It must be remembered, in examining red fibroids, that the diffusion of red pigment may spread considerably beyond the area of production. A great deal depends on the texture of the surrounding tissue, as a few simple experiments proved. Pieces of undegenerated

fibroids placed in normal saline containing laked corpuscles were, after seven days, penetrated only to a depth of one-eighth of an inch, while soft and degenerating fibroids, after the same time, showed a red tint from a quarter to half an inch from the surface.

The only point remaining is the actual site of the hæmolysis. I have occasionally observed some extravasation of corpuscles in the stroma of red fibroids. This escape from disorganized vessels no doubt leads to increase or continuance of the hæmolytic process, but in most cases no such extravasation can be seen, and the focus of hæmolysis must lie within the degenerated vessel itself.

(2) The clinical course associated with red degeneration. It is customary to write of red degeneration as being essentially associated with somewhat acute symptoms. In the majority of cases *reported after operation*, no doubt this is true, but as Bland-Sutton⁴ emphasizes "painfulness and tenderness are only markedly exhibited by red fibroids when associated with pregnancy." He continues by stating that "pain is present only in the early stages of the degenerative process." Fairbairn, in his monograph on 19 cases, found pain present in 16, but only in 11 of these was it severe, and the chief reason for the patients seeking advice. Lorrain Smith and Fletcher Shaw found "pain and rapid enlargement" present in all their four cases. In my series, three of the four presented no special or urgent symptoms, while the fourth, occurring during pregnancy, did show some urgency. The importance of appreciating the possibility that a red fibroid may remain unrecognized as such cannot be overestimated if we are to arrive at a true idea of the life history of these tumours. To point out that "red coloration is only rarely found in any large series of degenerating fibroids" is no conclusive evidence that such red coloration but seldom occurs *if* this bleaching action which I have described as occurring *in vitro* takes place in the body.

Any collection of cases will show extreme variation in degree of symptoms produced, ranging from a condition simulating acute torsion of the pedicle of an ovarian cyst or the like, to pain no greater than is found with any more ordinary form of degeneration in a fibroid of corresponding size or situation. It is, of course, difficult to separate in the acute cases symptoms due to the degeneration *per se* and to a superadded infection. Case 3, however, demonstrates that a very considerable degree of upset may arise in a red fibroid in which the most careful cultural experiments failed to find the presence of bacteria.

If such cases be left alone, Bland-Sutton affirms that the pain disappears. Is it necessary, then, to believe that *every* such fibroid would break down into the diffuent mass which he describes?

(3) The question of thrombosis. Lorrain Smith and Fletcher Shaw describe as present in their four cases a very pronounced thrombosis even to the very minute vessels. In three of these cases

the larger thrombi were distinctly visible to the naked eye. Stevens⁵ also records a case with pronounced thrombosis throughout the veins of the capsule. On the other hand, Fairbairn describes the capsule as always white and not engorged. While Taylor,⁶ from a study of 30 cases denies that thrombosis occurs in the majority.

All four of the cases in this present series showed fibrin in some of the smaller vessels, most marked perhaps in Case 1, where the colour was least intense, and certainly least marked in Case 4, where the colour was very deep. In no case was the capsule implicated.

The small total amount of thrombosis in these cases and its lack of proportion to the degree of hæmolysis, make one suspect that perhaps after all the thrombosis is *not* primary.

To begin with, it is quite apparent that in all degenerating fibroids of the starved type, whether necrobiotic, necrotic or hyaline, arrest of circulation and disintegration of the vessel wall can occur without thrombosis. Taking into consideration, then, the very diverse reports on the amount and extent of the thrombosis found, is it not very probable that the converse way of regarding the process is the more likely, namely, that the disorganization resulting from hæmolysis of the corpuscles, induces the deposit of fibrin in a vessel wall already partly disintegrated, and ready to precipitate such a deposit?

Furthermore, as Bland-Sutton⁴ pointedly asks: "If primary thrombosis is the cause of this hæmolytic reaction, why has it never been seen in such an ideal situation as an ovarian fibroid with twisted pedicle?"

Drawing a moral from such reasoning led me to examine for fibrin a short series of fibroids microscopically resembling red degeneration in their sparse nuclear staining and combined hyaline and granular degeneration, but presenting no trace of red colour. Seven were sectioned, and to these may be added the large grey fibroid from Case 3. In three of this total of eight cases, were found small degenerated vessels plugged with fibrin. These thrombi were certainly infrequent, but were undoubted.

That extensive thrombosis is largely responsible for the acute clinical picture associated with rapid enlargement is, I think, certain, but that it is primary I consider there is more evidence to disprove than prove.

Infection and thrombosis. The question of infection of red fibroids considerably complicates the problem of their pathology. Only rarely has the opportunity been taken thoroughly to test their sterility. Short of this the only method possible is direct examination with suitable stains. It does not follow that the infection, if present, is a coccal one; indeed on general grounds the most likely agent in abdominal infection is the Gram negative colon bacillus, and anyone with much experience of looking for a short bacillus among fibrous tissues will be ready to testify to the difficulties of the search. A negative report,

from such direct microscopical examination, is only of moderate weight. Of this nature, probably, is the case narrated by Fletcher Shaw⁷ (as he himself will be ready to admit), in which pain, temperature, serious illness and, finally, endocarditis were present in a case of red degeneration unassociated with pregnancy. Stevens'⁵ case, already referred to, where there was extreme thrombosis in the capsule and a layer of coagulated lymph between the capsule and the fibroid, is also very suggestive of infection, the only evidence negating it being an examination of sections with Gram's stain.

Bland-Sutton's⁴ case with staphylococcal infection of one red fibroid and sterility in several others in the same uterus, proves that a bacterial infection may be wholly secondary. At the same time, I cannot help feeling that it would be rash to assert that thrombosis (with arrest of escape of lipoids and perhaps consequent hæmolysis) in such cases is never primary. And it must be remembered that many organisms are strongly hæmolytic *per se*. The point, however, is a difficult one.

(4) Classification. Does this hæmolysis necessarily indicate that a red fibroid is a type by itself? Most emphatically I think not. Nothing is more certain than that many fibroids showing no red colour, yet present microscopical appearances identical with those seen in a red fibroid. Personally, I certainly would not care to pick out the red fibroids from a series of degenerating fibroids stained with hæmatoxylin and eosin or van Geison. In a fibroid, also, showing partial red degeneration, while one would not expect a sharp line of demarcation, since the colour is a matter of diffusion, still in parts removed from the red area the appearances may be identical with those observable in the area most affected. An apparently strong argument in favour of a special type is found in the low percentage of *red* fibroids in any series of degenerating fibroids. Against this I hope that I have shown—

Firstly, that not every red fibroid comes to operation—that the degeneration may be going on without necessarily leading to any symptom of urgency, especially if unassociated with pregnancy.

Secondly, that there is strong evidence that in time (whether short or long I cannot say) the red colour may disappear. This evidence is partly *in vitro* and partly microscopic. The largest fibroid in Case 3, goes far to prove this. Here was a fibroid presenting microscopic appearances identical with co-existing red fibroids, and yet itself presenting no trace of red colour, although every other fibroid larger than a pigeon's egg in the specimen was so coloured.

In this connection it is interesting to speculate on the nature of the grey-brown coloration seen in many degenerating fibroids. Is this a staining of the tissues or is it necrosis? It was found in Cases 1 and 2 after the red colour had been allowed to diffuse into

saline. With no evidence of breaking down, either macroscopically or microscopically, and taken in conjunction with the occasional deposit of fibrin in some of the very small vessels, such a colouration might justifiably make one suspect a previous hæmolysis. Nor need one expect *much* evidence of thrombosis in such a late condition, as organization is possible, if not very probable, in marked cases of degeneration.

The general type, too, of degenerating fibroid affected by hæmolytic changes is helpful in correctly placing these red tumours. It does not show that completely hyaline appearance, which, as I have shown in a previous paper,⁸ is readily produced even in dead fibroid tissue when the fluid elements of the blood are present in sufficient quantity or concentration to prevent autolysis. The transformation is as much granular as hyaline. In other words, there is a certain amount of autolysis in process.

Why, then, it may be asked, do not all breaking-down fibroids show red degeneration? Until the nature of the pigment is cleared up it will be impossible to answer definitely this query. The possibilities are two—either (1) that hæmolysis *does* go on, but from bleaching is unrecognized; or (2) that the lipoid is different in character when true necrosis is present. Cholesterin, which is very frequently found in these breaking-down cavities, is a well-known anti-hæmolytic.

Again, tinting of hyaline fibroids is, according to Kelly and Cullen,⁹ very marked in some cases. The few instances where I have noticed a marked brown tint were fibroids showing advanced circumscribed areas of hyaline change with—for hyaline degeneration—an unusually large amount of fat.

Finally, I should like to suggest a more rigid nomenclature. In the light of what I have said it would appear reasonable to apply the term “necrobiosis” to the whole group, and “necrobiosis with hæmolysis” to such specimens as show obvious diffusion of blood pigment.

The life-history, therefore, of *uncomplicated* red degeneration which I would put before you is as follows:—Hæmolysis takes place in some of the smaller degenerated vessels of a fibroid undergoing aseptic necrobiosis. This results from the action of hæmolytic lipoids associated with the degeneration, and is inaugurated by a lack of the control which plasma can exercise. As a result of this upset, thrombosis sets in and the course varies with the amount of this latter. If it be very extensive, the clinical picture so frequently seen in pregnancy is developed, with much pain and enlargement of the tumour. But if it be slight, the tumour may in time lose the red colour and appear later as a fibroid showing areas of dirty yellow, grey or brown.

CONCLUSIONS.

1. The lipoids of degenerating fibroids are markedly hæmolytic.
2. This hæmolytic action is readily restrained by blood plasma.
3. Excess of lipoid in a suspension of red blood corpuscles leads to the development of a grey or brown colour in place of the red.
4. Thrombosis in red degeneration is not primary.
5. Red degeneration microscopically is identical with certain other degenerating fibroids showing no red.
6. The accumulation of lipoid is not, in the first instance, dependent on the presence or amount of thrombosis, but on the degree of preceding degeneration.
7. Laking of the corpuscles has more relation to lack of the fluid constituents of the blood than to large excess of lipoid.
8. Many of the stains in fibroids—not necessarily *red* stains—may be due to old symptomless hæmolysis.

I am deeply indebted to Dr. Gemmell, Dr. Wallace and Prof. Kynoch for their kindness in placing at my disposal the material on which this paper is based.

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CHART I.

THE HÆMOLYTIC POWER OF THE LIPOIDS EXTRACTED FROM FOUR DEGENERATING FIBROIDS.

		After 2 hours.	After 24 hours.
CASE 5.			
1 cc. 3% R.B.C. + 1/10 cc. 1% emulsion	+		+
" + 1/8 cc.	+		+
" + 1/5 cc.	+		+
" + 2/5 cc.	Comp. fluid brownish red.		Comp. fluid bright red.
			Comp. fluid brownish red.
			Comp. brown deposit, fluid bleached with no trace of red.
CASE 1.			
1 cc. 3% R.B.C. + 1/10 cc. 1% emulsion	+ sl.		+
" + 1/8 cc.	+		+
" + 1/5 cc.	+		+
" + 2/5 cc.	Comp.		Comp. fluid red.
			Comp. fluid brownish red.
			Comp. brown deposit, fluid bleached with no trace of red.
CASE 6.			
1 cc. 3% R.B.C. + 1/10 cc. 1% emulsion	-		+ sl.
" + 1/8 cc.	+		+
" + 1/5 cc.	+		+
" + 2/5 cc.	+	+ fluid red.	Comp. fluid brownish red.
CASE 7.			
1 cc. 3% R.B.C. + 1/10 cc. 1% emulsion	+		+
" + 1/8 cc.	+		+
" + 1/5 cc.	+	+ fluid brownish red.	Comp. fluid brownish red.
			Comp. fluid brownish red.
			Comp. brown deposit, fluid bleached.

CHART II.

THE INHIBITION OF HÆMOLYSIS BY BLOOD SERUM.

		1/2 hour.	1 hour.	2 hours.	24 hours.
CASE 7.					
1/2 cc. 3% R.B.C. + 1/20 cc. 1% em.		-	+	+	+ brownish.
" " " + 6m. serum	+	-	-	-	-
" " " + 4m. "	+	-	-	-	+
" " " + 3m. "	+	-	-	-	+
" " " + 2m. "	+	-	+ sl.	+	+ brownish red.
" " " + 1m. "	+	-	+	+	+ brownish.
" " " + sl., +, +, +, Comp.					indicate degrees of hæmolysis.