These differences, in our opinion, are due to the substances with which the proteid is associated in the two seeds, for saturation of the pea extracts with sodium chloride, before precipitating the legumin by dialysis, greatly diminished the amount of coagulum given by the pea legumin.

3. Besides the legumin, the pea and vetch contain another proteid in small amount, either an albumin or a globulin, soluble in extremely dilute salt solutions, and coagulated by heating its solutions to 80°. This substance we have not studied further than to make two preparations for analysis from the pea and one from the vetch. These were obtained in an insoluble form by coagulating with alcohol, so that the properties and reactions were not determined. The composition of this proteid is shown by the following average of three closely agreeing analyses:

PROTEID OF PEA AND VETCH.

Carbon	53.48
Hydrogen	6.89
Nitrogen	16.43
Sulphur	1.01
Oxygen	22.19
	100.00

4. In addition to the foregoing proteids a very little *proteose* was found in the extracts of both these seeds.

5. No attempt has yet been made to determine the total quantity of proteids in these seeds, nor to study minutely the proteids that occur in them in small proportion.

CONGLUTIN AND VITELLIN.[1]

BY THOMAS B. OSBORNE AND GEORGE F. CAMPBELL.

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REVIEW of the literature relating to the plant proteids hitherto described as conglutin and vitellin, shows that the subject is in great confusion, which can only be cleared up by a thorough examination of the seeds from which these proteids are said to have been obtained. This is the more important, because of late years various investigations have been made in

[1] From the Report of the Connecticut Agricultural Experiment Station for 1895. Communicated by the authors.

which these proteids have figured as the subject of study, while the fact, that the purity or even the identity of the proteid employed is very doubtful, has been entirely overlooked or ignored. Thus the results of observations on the globulin of lupins have been applied to the globulin of the squash, hemp and other seeds, it being apparently unknown that these two proteids are very distinct substances. Further, the composition and reactions of most of these bodies have never been adequately studied, nor the means of preparing them in a state of purity ascertained. Recent authors are mostly content to call these proteids vegetable vitellin and to assume, with little reason, that the proteid from the many seeds in which vitellin has been said to occur is one and the same substance. With the object of determining, so far as may be practicable, the true relations of the globulins found in the various seeds hitherto alleged to contain conglutin and vitellin, this investigation was undertaken.

ALMONDS.

The proteid first discovered, which has since been known as conglutin, was found in the seed of the almond by Proust,[1] and by him named amandin.

Dumas and Cahours[2] described and analyzed preparations obtained from almonds, peach and plum seeds, and considered them to be legumin, identical with that of a large number of other seeds.

According to Rochleder[3] the proteid described by Dumas and Cahours is different from legumin as understood by Liebig and others. Norton[4] analyzed proteid preparations which he obtained from the almond and considered them to be legumin. Ritthausen[5] described the proteid of the almond under the name conglutin. He later[6] obtained from the peach kernel a proteid which he considered to be conglutin, identical with that of almonds and lupins.

The details of our investigation are as follows: A quantity of

[1] *J. de phys., de chim., d'histoire naturelle et des arts*, 54, 199.
[2] *J. prakt. Chem*, 28, 398.
[3] *Ann. der Chem. u. Pharm.*, 46, 155.
[4] *Am. J. Sci.*, [2], 5, 22.
[5] Eiweisskörper, Bonn, 1872.
[6] *J. prakt. Chem.*, 26, 422, *1882*.

sweet almond meats deprived of the brown skin (tegmen) were crushed and treated with ether to remove oil. Seventy-five grams of the oil-free meal was then extracted with ten per cent. sodium chloride solution, the extract was filtered clear and dialyzed until free from chlorides. The globulin separated at first in minute spheroids, which, on settling to the bottom of the dialyzer, united, forming a viscid semi-fluid translucent mass of a pale straw color. After decanting the solution, the globulin, which had separated, was again dissolved in ten per cent. sodium chloride brine and reprecipitated by dialysis. The proteid, obtained in the same condition as before, was washed with water, and with alcohol, dilute at first and afterwards gradually increased in strength, and finally was dehydrated with absolute alcohol and dried over sulphuric acid. This preparation, 1, weighed 6.72 grams, was a snow white, dense powder, and, after drying at 110°, gave the following results on analysis :

AMANDIN, 1.

				Average.
Carbon	51.49	51.32	....	51.41
Hydrogen	7.33[1]	6.86	....	6.86
Nitrogen	19.29	19.52	19.62	19.47
Sulphur	0.39	....	....	0.39
Oxygen	....	....	....	21.87
				100.00
Ash	0.24			

Another preparation of this globulin was made by crushing a quantity of fresh, shelled, "Jordan almonds," and extracting the oil with petroleum naphtha. After freeing from naphtha, the greater part of the skins was separated by sifting. 100 grams of the meal was then extracted with one liter of water and the solution filtered and saturated with ammonium sulphate. The precipitate produced was filtered out, dissolved in water, the resulting solution filtered perfectly clear and dialyzed until free from chlorides. The proteid, which on dialysis deposited with the same appearance and characters as the first preparation, was washed with water, dilute alcohol, stronger alcohol and then dehydrated with absolute alcohol and dried over sulphuric acid.

[1] Omitted in average.

Sixteen grams were obtained, equal to sixteen per cent. of the meal. This preparation, owing to the seed-integument, which had been but partly removed, was somewhat red in color. After drying at 110°, analysis gave the following results:

AMANDIN, 2.

			Average.
Carbon	51.49	....	51.49
Hydrogen	6.85	....	6.85
Nitrogen	19.27	19.05	19.16
Sulphur	0.44	....	0.44
Oxygen	....	....	22.06
			100.00
Ash	0.80		

For a third preparation Jordan almonds were drenched with hot water for a moment to loosen the skins, which were then easily detached; the meats were squeezed in a drug press to separate the greater part of the oil. The remainder of the oil, after dehydrating the pressed meats with absolute alcohol, was extracted with naphtha. The residue was freed from naphtha by evaporation and ground to a fine powder. There was thus obtained from 900 grams of almonds 380 grams of oil-free meal. This was thoroughly extracted with ten per cent. sodium chloride brine and the extract filtered. A turbid liquid resulted which was saturated with ammonium sulphate. The proteid thus precipitated was dissolved in ten per cent. sodium chloride brine and the solution after filtering perfectly clear was dialyzed until nearly free from chlorides. The solution was then decanted from the semi-fluid, viscid precipitate which had formed, and this was washed with water and alcohol, dehydrated with absolute alcohol and dried over sulphuric acid. The proteid thus obtained weighed sixty-six grams. The filtrate from this preparation was saturated with ammonium sulphate, the precipitate was filtered out, dissolved in a little water and the filtered solution was dialyzed. This second dialysis yielded twenty-seven grams more of globulin which were added to that before obtained, making in all ninety-three grams, being twenty-four and one-half per cent. of the oil-free meal. Analysis of this preparation, 3, dried at 110°, gave results as follows:

AMANDIN, 3.

			Average.
Carbon	51.18	....	51.18
Hydrogen	6.99	....	6.99
Nitrogen	19.30	19.37	19.33
Sulphur	0.48	....	0.48
Oxygen	....	....	22.02
			100.00
Ash	0.35		

A portion of 3 was dissolved in sodium chloride solution and dialyzed into dilute alcohol in the hope of obtaining the globulin in the form of crystals. No distinct crystals resulted, and after remaining about two weeks in alcohol the precipitated proteid was readily redissolved in salt solution, not having been coagulated by the alcohol, and the clear solution was dialyzed in water until free from chlorides. After washing and drying in the usual manner this preparation, 4, was analyzed:

AMANDIN, 4.

	I.	II.	Average.
Carbon	51.39	51.32	51.36
Hydrogen	6.99	6.90	6.95
Nitrogen	19.32	19.36	19.34
Sulphur	0.45	....	0.45
Oxygen	....	....	21.90
			100.00
Ash	0.20		

PEACH KERNEL.

Ritthausen states that peach seeds contain the same proteid as the almond, a fact in harmony with the close botanical relations of the two plants.

We obtained this proteid from peach pits in the following manner: The seeds were freed from the skin (tegmen) by cutting it away with a knife and were then ground with ether to a powder and freed from oil. Only a small quantity of seeds, yielding but twenty grams of oil-free meal, were at the time available. This was extracted with ten per cent. sodium chloride solution and the clear filtered extract dialyzed. The globulin separated in spheroids, which settled to a translucent viscid semi-fluid mass like that from the almonds. The solution, when freed from chlorides

by dialysis, was decanted from the precipitate and the latter was washed with water, alcohol and absolute alcohol and dried over sulphuric acid; 2.44 grams or 12.2 per cent. of the meal were so obtained. Analysis of this preparation gave the following results:

AMANDIN, FROM THE PEACH, 5.

			Average.
Carbon	51.06	51.02	51.04
Hydrogen	6.86	6.79	6.83
Nitrogen	19.20	19.35	19.28
Sulphur	0.48	....	0.48
Oxygen	....	....	22.37
			100.00
Ash	0.62		

Owning to the small quantity of 5, it was not possible to compare its reactions throughout with those of amandin from the almond, but, so far as could be observed, the two were identical in all respects, and there can be no doubt that they are the same substance.

In the following table the foregoing results may be compared with those obtained by earlier investigators, in their work upon the proteid of the almond, peach and plum:

AMANDIN.

	Dumas and Cahours.		Löwenburg.		Norton.	
	Almonds.	Plums.	Almonds.		Almonds.	
Carbon	50.89	50.93	51.10	50.50	50.97	49.16
Hydrogen	6.71	6.73	7.20	6.56	6.64	6.51
Nitrogen	18.93	18.64	....	17.33	17.15	17.43
Sulphur	....	....	....	0.32	0.27	0.41
Phosphorus	....	....	....	1.05	0.57	2.21
Oxygen	23.47	23.70	....	24.24	24.40	24.27
	100.00	100.00		100.00	100.00	100.00

Ritthausen.

	Almonds	Peach.
Carbon	50.44	50.82
Hydrogen	6.85	6.94
Nitrogen	18.61	18.60
Sulphur	0.43	0.32
Oxygen	23.67	23.32
	100.00	100.00

AMANDIN.

	Osborne and Campbell, Almonds.				Peach.	
	1	2	3	4	5	Average.
Carbon	51.41	51.49	51.18	51.36	51.04	51.30
Hydrogen ...	6.86	6.85	6.99	6.95	6.83	6.90
Nitrogen	19.47	19.16	19.33	19.34	19.28	19.32
Sulphur	0.39	0.44	0.48	0.45	0.44	0.44
Oxygen	21.87	22.06	22.02	21.90	22.37	22.04
	100.00	100.00	100.00	100.00	100.00	100.00

Amandin, that has been dried over sulphuric acid, when mixed with cold water dissolves to a very slight extent and forms a gummy plastic mass. In water heated to about 98° amandin melts to a transparent mass and a considerable portion goes into solution, which in part separates out on cooling, and is redissolved on heating again. Boiling the solution causes but a slight turbidity.

The precipitate formed by cooling the hot water solution of amandin, dissolves completely on addition of a little nitric acid, but if more nitric acid be added, a precipitate falls which dissolves on warming and reappears on cooling in exactly the manner of a proteose.

In ten per cent. sodium chloride solution this proteid dissolves readily to a slightly opalescent liquid, no insoluble "albuminate" being formed by drying, as is the case with most vegetable globulins.

A solution containing ten per cent. of amandin dissolved in ten per cent. sodium chloride brine gives an abundant precipitate when poured into much distilled water, but if only a small amount of proteid is dissolved in the brine no precipitate is produced by dilution.

Salt solution of amandin is not precipitated by saturating with sodium chloride. By saturating with magnesium sulphate it is partly thrown down. Saturation with sodium sulphate or ammonium sulphate completely precipitates it.

Nitric acid added to the sodium chloride solution forms a precipitate soluble in an excess of acid which, on heating, gives the usual xanthoprotein reaction.

With mercuric chloride solution no precipitate is formed.

With picric acid and also with tannic acid heavy precipitates are produced.

Amandin is readily soluble in very dilute acetic acid. The acetic solution yields an abundant precipitate with potassium ferrocyanide that is difficulty soluble in an excess of this salt to a solution precipitable by diluting with water. In concentrated glycerol the dry proteid dissolves quite readily, the clear solution yielding a considerable precipitate on adding absolute alcohol.

Concentrated hydrochloric acid dissolves it, with development of a violet-blue color on standing. By heating in quite dilute sulphuric acid a solution is obtained which becomes turbid on cooling, the proteid being far less soluble in sulphuric than in hydrochloric or acetic acids. With the biuret test and also with glacial acetic acid and concentrated sulphuric acid together, solutions of this globulin give a fine violet color.

After solution in very dilute potash water and precipitation by neutralizing with acetic acid, amandin retains its original solubility in salt solutions.

A ten per cent. sodium chloride solution, containing five per cent. of amandin, becomes turbid when heated to 75°, and at 80° flocks form in small quantity which slowly increase on gradually raising the temperature, but only a small part of the proteid is coagulated even by boiling.

Having thus, as we believe, established this proteid as a chemical species quite distinct from all others hitherto investigated, it is proper to restore the designation *Amandin* given it by Proust, its discoverer, and to discard for it the names vitellin and conglutin, which are associated with many erroneous statements as to its occurrence, composition and characters.

WALNUT, (*Juglans regia*).

Ritthausen[1] prepared the proteid from this seed, but owing to the large amount of tannin present in the skins, he found much difficulty in obtaining satisfactory results.

As Ritthausen's preparations differed widely in composition,

[1] *J. prakt. Chem.*, 24, 257.

and as he has published nothing respecting the properties of this proteid, we have made several preparations with the following results.

A quantity of walnut meats was crushed, freed from oil by extracting with petroleum naphtha, and the greater part of the skins removed by sifting. One hundred grams of this meal was then extracted with ten per cent. sodium chloride brine and, after filtering, eight-tenths of the salt solution applied was recovered as a clear extract corresponding to about eighty grams of meal. This was saturated with ammonium sulphate and the resulting precipitate filtered out and treated with salt solution. Much that failed to dissolve was separated by filtration and the clear solution was dialyzed until free from chlorides. During dialysis the proteid was deposited in spheriods which did not. like amandin, unite to a confluent mass. The precipitated globulin was then filtered out, washed with water, alcohol and absolute alcohol and dried over sulphuric acid. Only 2.87 grams was obtained, equal to about 3.6 per cent. of the meal. This small yield was undoubtedly due to tannin, which rendered the greater part of the proteid insoluble in salt solution.

Dried at 110° this preparation, 6, had the following composition:

WALNUT GLOBULIN, CORYLIN, 6.

			Average.
Carbon	50.32	50.32	50.32
Hydrogen	6.63	6.74	6.69
Nitrogen	19.06	19.12	19.09
Sulphur	....	....	23.90
Oxygen	....	....	
			100.00
Ash	0.63		

The part of the ammonium sulphate precipitate which was not taken up by salt solution at 20° was treated with brine at 60°. In this it dissolved almost completely and did not precipitate on cooling. The clear filtered solution was dialyzed free from chlorides, and by the usual process, 2.82 grams or 3.5 per cent. of globulin was obtained, having the following composition:

WALNUT GLOBULIN, CORYLIN, 7.

Carbon	50.83	
Hydrogen	6.79	
Nitrogen	19.05	19.04
Sulphur	0.89	
Oxygen	22.44	
	100.00	
Ash	0.15	

In order to avoid the presence of tannin, another lot of walnut seeds were drenched for a moment with hot water, whereupon the skins were easily stripped off. The crushed meats were then treated with ether to extract the oil and, after removal of ether by exposure to the air, the coarse meal was finely ground and fifty grams was extracted with 1500 cc. of ten per cent. brine of common salt. The extract was filtered clear, saturated with ammonium sulphate, the resulting precipitate dissolved in salt solution at 40° and the extract dialyzed free from chlorides. The precipitated globulin was then filtered out and treated in the usual manner, giving preparation 8, weighing ten grams, equal to twenty per cent. of the meal, and having the following composition:

WALNUT GLOBULIN, CORYLIN, 8.

			Average.
Carbon	50.77	50.74	50.76
Hydrogen	6.94	6.83	6.89
Nitrogen	19.10	19.02	19.06
Sulphur	....	....	} 23.29
Oxygen	....	....	
			100.00
Ash	0.32		

HAZEL-NUT OR FILBERT, (*Corylus tubulosa*).

Ritthausen[1] has detailed the resuits of his examination of the proteid of this seed and concluded it to be identical with the conglutin which he obtained from almonds.

In order to satisfy ourselves respecting this substance a quantity of hazel-nut meats was freed from skins and oil as already described in case of walnuts, and finely pulverized. The meal

[1] *J. prakt. Chem.*, 24, 257.

was then extracted with ten per cent. sodium chloride brine and the filtered extract saturated with ammonium sulphate. The precipitated proteid was filtered out, dissolved in salt solution, and the liquid, after filtering clear, was dialyzed free from chlorides.

During dialysis the globulin separated in spheroids which, like those of walnut globulin, settled down, without adhering together to a plastic mass, after the manner of amandin. The precipitated globulin was filtered out and treated in the usual way. When dried at 110° this preparation had the following composition :

CORYLIN, FILBERT GLOBULIN, 9.

			Average.
Carbon	50.64	50.80	50.72
Hydrogen	lost	6.86	6.86
Nitrogen	19.14	19.19	19.17
Sulphur	0.83	....	0.83
Oxygen	....	....	22.42
			100.00
Ash	0.28		

In properties this preparation exactly resembled the globulin obtained from the walnut. That the two are identical in composition is shown by the following statement :

CORYLIN.

	Walnuts			Filberts.
	6	7	8	9
Carbon	50.32	50.83	50.76	50.72
Hydrogen	6.69	6.79	6.89	6.86
Nitrogen	19.09	19.05	19.06	19.17
Sulphur }	23.90	0.89 }	23.29	0.83
Oxygen }		22.44 }		22.42
	100.00	100.00	100.00	100.00

The properties of this proteid, after drying over sulphuric acid, as exhibited by preparations 8 and 9, are as follows. In the dry state it forms a heavy snow-white powder which, unlike amandin, is entirely insoluble in distilled water at 20° or at 40°. In ten per cent. sodium chloride solution it dissolves readily and completely, as also in exceedingly dilute acids and alkalies. Sulphuric acid, however, dissolves it much less readily than acetic, hydrochloric or nitric acid.

The solution in ten per cent. sodium chloride brine, containing ten per cent. of this globulin, gives an abundant precipitate when diluted with an equal volume of water. More dilute solutions give precipitates on sufficient dilution. Corylin is very much more readily precipitated by dilution than amandin. Hydrochloric acid and acetic acid each gives a precipitate insoluble in considerable excess of acid, when added to saline solutions of the proteid. With mercuric chloride, picric acid, or tannic acid dissolved in ten per cent. sodium chloride brine, heavy precipitates are produced. Saturation with sodium chloride gives a slight precipitate. Saturation with magnesium sulphate produces a considerable though partial precipitation. Saturation with sodium sulphate or ammonium sulphate effects a complete precipitation.

Dissolved in a little acetic acid, a precipitate is produced by sufficient nitric acid, which dissolves on heating and partly reprecipitates on cooling, The solution in acetic acid gives a precipitate with potassium ferrocyanide, but slightly soluble in a large excess of the latter.

With the biuret test the usual violet color is obtained. With Millon's and the xanthoprotein tests the ordinary proteid reactions appear. Dissolved in concentrated hydrochloric acid and boiled, a violet blue color develops on standing.

With glacial acetic acid and concentrated sulphuric acid, solutions of corylin give a violet color. When five per cent. of this proteid is dissolved in ten per cent. sodium chloride brine and the solution heated, turbidity ensues at about 80° and flocks form in small amount at 99°. On boiling the solution, a little more coagulates, but the corylin is precipitated by heat very slowly and incompletely.

When dissolved in dilute potash water and precipitated by neutralization, the proteid dissolves completely in ten per cent. salt solution. These reactions and the results of analysis show this body to be entirely distinct from either amandin or edestin. We therefore propose the name *Corylin*, from the generic name of the filbert, *Corylus tubulosa*, in which this proteid was first found by Dumas and Cahours.[1]

[1] *J. prakt. Chem.*, **28**, 398.

BRAZIL-NUT, (*Bertholletia excelsa*).

Weyl[1] described the globulin of the Brazil-nut under the name of vegetable vitellin, and first determined its composition with a close approach to accuracy.

One of us has already investigated this substance as to its composition and properties, when prepared both in the form of spheroids and as perfectly distinct crystals.[2] This proteid, being evidently different from all others hitherto examined, deserves a distinct name, and we accordingly propose to designate it *Excelsin*.

OAT-KERNEL.

From the oat-kernel one of us[3] obtained a crystallized globulin very similar in composition to excelsin, but different in its reactions as well as in crystalline form. This globulin might be classed as a vitellin, and for that reason is here referred to. As yet this proteid has received no specific name and we now propose to call it *Avenalin*.

HEMP, (*Cannabis sativa*), SQUASH, (*Cucurbita maxima*), AND CASTOR BEAN, (*Ricinus communis*).

Proteid preparations from the seeds of hemp, squash and castor bean have been described under the names of conglutin and vitellin. One of us[4] has shown that these seeds contain, as their chief and characteristic proteid, one and the same substance and has named it *Edestin*. This has been found in a larger number of seeds than any proteid yet discovered, and is the body most commonly called vegetable vitellin. It is readily obtained pure in octahedral crystals, from several seeds, and owing to this fact has been employed in physiological investigations. That it is a different substance from the proteids already described in this article appears to have been mostly overlooked. The properties and composition of edestin are detailed in the paper above mentioned, and in the annual reports of Connecticut Experiment Station for 1893, pp. 179, 214, 216, and 1894, pp. 155, 170, 190.

COCOANUT, (*Cocos nucifera.*)

The proteid of the cocoanut was examined by Ritthausen[5]

[1] *Ztschr. phys. Chem.* 1, 85.
[2] Osborne: *Am. Chem. J.*, 14, 662.
[3] Osborne: Reports of Connecticut Experiment Station 1890 and 1891, and *Am. Chem. J.*, 14, 212 and 682.
[4] Osborne: *Am. Chem. J.*, 14, 671–689.
[5] Pflüger's Archiv., 21. 96.

who, without identifying it with conglutin, assigned to it a similar composition. Chittenden[1] under the general name phytovitellin, gives the composition of this proteid in close accord with that of edestin, and as he obtained it partly crystallized in octahedra it probably is edestin.

LUPIN (*Lupinus.*)

The principal proteid contained in lupin seeds is the body to which Ritthausen first gave the name conglutin.[2] We have devoted much labor to the study of this proteid, but the results of our work are not yet complete and will form the subject of a future paper. We find that it is distinctly different in composition and properties from the proteids which we have hitherto noticed, and we take especial pleasure in confirming to it the name *conglutin* proposed by its veteran discoverer.

We give on the following page the composition of conglutin as found by us in accordant analyses of six preparations from the blue lupin.

SUNFLOWER (*Helianthus.*)

The proteid of the sunflower seed as described by Ritthausen[3] appears to be identical with edestin, but our investigation of this substance, which is still in progress, shows that the proteid prepared by the usual methods is contaminated with the helianthotannic acid described by Ludwig and Kromayer.[4] As yet we have been unable to obtain this proteid in the pure state.

To the best of our knowledge the proteids noticed in this paper include all which have been hitherto designated either as conglutin or vitellin. Of late years many seeds have been described as containing vitellin, but its presence has been inferred from qualitative reactions and not, except in those cases mentioned in this paper, from a study of the isolated proteid.

We have accordingly at least six perfectly distinct proteids which have been confounded together under the name vitellin or conglutin. The following table shows the present state of our knowledge concerning the composition of these globulins and sets forth the characters in whlch they have been found to differ.

1 Medical Record, 45, 450, and Digestive Proteolysis, New Haven, 1895, p. 32.
2 Eiweisskörper, Bonn, 1872, and *J. prakt. Chem.*, 25, 422.
3 Pflüger's Archiv., 21, 81.
4 N. Br. Arch., 99, 1 and 285.

PROTEIDS FORMERLY KNOWN AS VITELLIN OR CONGLUTIN.

	Edestin.	Amandin.	Corylin.	Excelsin.	Avenalin.	Conglutin.
Carbon	51·65	51·30	50·72	52·18	52·18	51·00
Hydrogen	6·89	6·90	6·86	6·92	7·05	6·90
Nitrogen	18·75	19·32	19·17	18·30	17·90	17·99
Sulphur	0·85	0·44	0·83	1·06	0·53	0·40
Oxygen	21·86	22·04	22·42	21·54	22·34	23·71
	100·00	100·00	100·00	100·00	100·00	100·00
Salt solution saturated with:						
Sodium chloride.	No pp.	No pp.	No pp.	No pp.	Complete pp.	No pp.
Magnesium sulphate.	Complete pp.	Partial pp.	Partial pp.	Slight pp.	Complete pp.	No pp.
Mercuric chloride.	Pp.	No pp.	Pp.	No pp.	Pp.	No pp.
Solution of ten per cent. proteid and ten per cent. sodium chloride diluted with equal volume of water gives:	Pp.	No pp.	Pp.	Slight pp.	Pp.	No pp.
Heat coagulation:						
Turbidity.	88°	75°	80°	70°	No coagulation even on boiling.	Trace of coagulation at 99°, sets to jelly on cooling.
Flocks.	95°	80°	99°	84°		
Precipitate by dialysis:	Octahedral crystals or spheroids, pulverulent.	Spheroids, uniting to viscid semi-fluid.	Spheroids, pulverulent.	Hexagonal plates or spheroids, pulverulent.	Spheroids, pulverulent.	Spheroids uniting to plastic mass.
Found in seeds of:	Hemp, Castor bean, Squash, Flax, Cotton, Wheat, Rye, Barley, Maize, Cocoanut.	Almond, Peach.	Walnut, Filbert	Brazil-nut.	Oat.	Lupin.