however, in this commodity to merely take borings, but it is necessary to break a large number of cakes and examine the fractured surfaces for indications of mould, both of the active green variety and dry mould mustiness and bad flavor.

SEED, HULLS AND LINT

I shall leave the report on sampling these materials largely to Mr. Hamner as, naturally, we do not come in contact with Hulls and Lints in this district.

We have found that in the sampling of almost all kinds of Seeds it is satisfactory to draw a five per cent sample, using a thief of proper size to permit the seeds to flow freely into it, and to reach well beyond the center of the container. In drawing percentage samples, samplers should be instructed to note whether or not the material from different containers runs with a fair degree of uniformity, and to note by use of the physical senses whether mould, must, worms, vermin, etc., are present in any of the containers sampled. If there is any doubt as to the presence of these it is then desirable to dump out some of the bags full and look them over carefully.

In sampling peanuts, all samples are drawn by hand, as sampling by thief tends to split the peanuts and this affects their value. This does not refer to bulk peanuts sold for crushing purposes. It would be satisfactory to sample these by thief.

We do not have peanuts in bulk, and while it is to be presumed that bulk peanuts could be sampled after the same fashion as under any similar commodity, I would be glad to have Mr. Hamner outline procedure employed by the crushers in the South in sampling large lots of peanuts as they are obtained from the growers.

MISCELLANEOUS PRODUCTS

We have been advised by Mr. Hanks that nothing has been brought to his attention coming under the caption of "Miscellaneous Products" that is not already included in the above report, which meets with his approval.

MEMBERS ENROLLED SINCE MARCH

By Thos. B. Caldwell, Sec'y., Wilmington, N. C.

ACTIVE MEMBERS

Harrison E. Howe, Editor, Ind. and Eng. Chem., 810 18th St., N.W., Washington, D. C.

Edward Vernon Kyser, Station W., Winter Place, Cincinnati, O.

Chas. Newel Huggins, Portland Vegetable Oil Mills Co., Portland, O.

Wayland D. Hutchins, Southern Cotton Oil Co., Savannah, Ga.

Bernard John Russell, 346 W. Grand Boulevard, Detroit, Mich.

Frank A. Lee, 1713½ Young St., Dallas, Texas.

G. Vernon Green, 2802 S. Kilbourne Ave., Chicago, Ill.

Jacob Monroe Carter, Liberty Cotton Oil Co., Texarkana, Texas

CORPORATION MEMBERS

Victor Labadie, Traffic Mgr., Willits and Patterson, No. 1 Drumm St., San Francisco, Cal.

Cia. Industrial Jabonera de Laguna, S. A., Gomez Palacio, Durango, Mexico.

The Duriron Company, Dayton, Ohio.

Henry W. Peabody and Co., 64 Pine St., San Francisco, Cal.

AMMONIA COMMITTEE REPORT 1921-1922

By H. C. Moore, Chairman, Armour Fertilizer Works, Chicago

The Ammonia Committee for the year 1920-1921, requested all collaborators in the check meal work, by means of a questionnaire, to state the details of their procedure in making determinations for ammonia. The same Committee also studied, by means of co-operative work, the relative merits of the Gunning-Mercury vs. the Gunning-Copper Method. The report of this work appeared in the October and November numbers of the COTTON OIL PRESS.

The Ammonia Committee for the current year decided to study only one important factor, namely, the standard solutions and particularly the standard acid solution, using in this connection the two standard chemicals recently prepared especially for the American Oil Chemists' Society. The standards, namely—Sodium Carbonate and Ammonium Sulfate—were manufactured by the General Chemical Company, the preparation being arranged for by the writer and the purchase by the late Dr. F. N. Smalley.

The Sodium Carbonate was made from the bi-carbonate by the method described in Scott's "Standard Methods of Chemical Analysis" page 501. Synthetic ammonia was used in the manufacture of the ammonium sulfate. Several hundred pound lots of these chemicals were made and each thoroughly mixed to insure uniformity before packing in ¼ lb. bottles.

A letter was sent on December 9th, 1921, to the 88 collaborators reporting ammonia determinations on the check meal samples, inviting their co-operation, first, by purchasing from Mr. Herbert S. Bailey the Standard Chemicals above named and making the following determinations:

SODIUM CARBONATE

Heat a small quantity in a platinum dish or crucible for five or ten minutes to only a dark red. Cool in a desiccator and determine the per cent of sodium carbonate by means of your standard acid solution, using the method described on page 30 of the COTTON OIL PRESS for October, 1921, as follows:

"Transfer 0.7897 gram or 1.3197 gram sodium carbonate (equal respectively to 29.80 cc. and 49.80 cc. half normal solution) preferably into a 500 cc. Pyrex Erlenmeyer flask and add 50 to 100 cc. of distilled water. The acid solution approximately half normal, 30.00 cc. or 50.00 cc. is carefully run in and the solution heated gently to boiling, continuing boiling for 15 minutes to expel CO₂. A small filtering funnel inserted in the neck of the flask prevents loss during boiling of acid and carbonate mixture. Add from one-half to one cc. phenolphthalein and add caustic soda solution N/4 or N/10 until a faint permanent pink is obtained. If N/4 caustic soda is used, the number of cc. required, divided by two and added to 29.80 or 49.80, gives the equivalent in terms of N/2 solution of the quantity of acid solution taken. Phenolphthalein solution contains one gram of the powder per liter of grain or denatured alcohol. In case denatured alcohol is used formula No. 30 is preferable."

NOTE: For the titration Pyrex Glassware is recommended. Instead of the small funnel to be inserted in the neck of the flask to prevent spattering during boiling, a reflux condenser made of a glass tube about 1-1.5 cm. diameter, fitted into a rubber stopper and of such length that during boiling to expel the CO₂, no vapor passes from the end of the tube, is also suggested.

AMMONIUM SULFATE

Pulverize a quantity in an agate mortar and dry in an oven at 100° to 130° C. After cooling in a desiccator make determinations by the three methods as described

on page 31 of the COTTON OIL PRESS for October as follows:

"Transfer a quantity (0.8517 gram or more) to a Kjehldahl flask and proceed by the following:

(1) Add about 300 to 400 cc. water, five grams of magnesium oxide (preferably heavy) and distill the ammonia into a measured quantity of standard acid.

(2) Add two grams pure cane sugar, the usual quantities of sulfuric acid, mercury or copper, potassium or sodium sulfate and digest as in the case of ammonia determination for organic materials. Cool, dilute and distil with an addition of sulfide and caustic soda solution in the usual manner. Collect the ammonia in a measured quantity of standard acid.

(3) Omit ammonium sulfate at first, digesting two grams cane sugar with other reagents, as in No. 2, and after cooling add the ammonium sulfate then proceed as in No. 2.

The Committee has planned to divide this year's work into two stages; the first as above described, using the two standard chemicals, and for the second to send to those reporting on the first stage a portion of a stock sulfuric acid solution, approximately half normal for determination of its acid value. The reports on the two chemicals were so long delayed as to leave insufficient time for the second stage of the work. It was then decided to allow more time for collaborators to complete the first stage and omit the second.

A brief questionnaire concerning the standard solutions and other information pertaining thereto was sent with the letter of December 9th. Twenty-four replies and reports have been received. A number of others have expressed regret for their inability to complete the tests. In many laboratories during the past year the personnel has been so reduced as to make it almost impossible to undertake other than the daily routine.

The values reported for the chemicals and the replies to the questionnaire appear briefly in Table I and one will note that, with few exceptions, the concordance between the results reported is quite satisfactory. The results for the sodium carbonate are in slightly closer agreement than those for the ammonium sulfate. From this one may quite reasonably infer that the usual discordance between the results of determinations for ammonia reported on the check meal work is due only in a small measure to discrepancies in the standard solutions and this, of course, includes errors in volumetric apparatus such as burettes, etc. The percentage difference between the highest and lowest results on the sodium carbonate, namely—0.39% would, if applied to an 8% meal, amount to only 0.03% ammonia or an average plus or minus error of only 0.015% ammonia. The corresponding error on the ammonium sulfate, while slightly greater, if applied to an 8% meal, is only about plus or minus 0.02% ammonia.

Referring to results reported for the sodium carbonate, Table I, it will be observed that 21 of the 24 results are in quite good agreement, 99.63 to 100.02; 19 of this number are between 99.68 and 100.00; while 17 are between 99.72 and 99.99 and 15 are between 99.83 and 99.98% with an average of 99.91%. This latter discrepancy is within the permissible error even for standard volumetric apparatus. The sodium carbonate is evidently of very high purity and indicates that 99.90% would be a safe value to accept.

For the ammonium sulfate the results show a somewhat greater variance but after eliminating those which are apparently most divergent, the concordance is very good. The difference in the degree of concordance between the results for the two chemicals may indicate the magnitude of the errors in digestion, distillation, titration and blank corrections, etc. in case of the ammonium sulfate which do not apply to the sodium carbonate. The percentage difference between the high-

est and lowest results on the ammonium sulfate (omitting the results marked with a star) if applied to an 8% meal would amount to a maximum of 0.04% ammonia, or an average plus or minus error of 0.02%.

From the foregoing one may reasonably conclude that the usual divergence in an equal number of reports for a sample of meal or other organic nitrogenous material is due only in a small measure to the standard solutions, distillation, titration, etc. To what extent errors enter due to digestion is impossible to state. The only probable error from the digestion of ammonium sulfate would be loss of ammonia during digestion which is unlikely unless there is excessive evaporation of the acid or the heat too great above the surface of the acid. This may be easily avoided by an asbestos ring. In the case of an organic material, the error will more likely be due to incomplete digestion.

The writer, however, desires to venture the guess that at least some of the greatest errors have entered by the time the sample has been transferred to the digestion flask, not to inaccuracy in weighing but in failing to weigh an average portion; also to change of moisture in the sample in a hot dry atmosphere or in a cool damp one. The writer believes the failure to weigh an average portion is the greater source of error for the following reasons:

Assume each sample box contains a correct average of the gross sample. In case of coarse samples, either mixed meals or those containing fine and coarse material such as meal and hulls, the mixture is not perfect and cannot be made so. Uniformity of mixture is less for coarse samples. Some analysts before weighing, mix the sample on a smooth surface as carefully as possible, spread to a thin layer and when weighing take small portions from a number of places. Others do not mix but weigh directly from the box in which the sample is received, thus taking the portion practically from one spot. The adjustment of weight is often made by taking a considerable portion of the amount being weighed, on the end of a spatula and tapping with the finger until more than sufficient has been transferred to the weighing pan. Some of the sample is then taken off and the operation repeated until finally the correct weight is obtained. This is not good practice, especially if more than a very small percentage of the weight is involved as the tendency is to segregate the coarse and fine material. This has been established as a fact in case of certain highgrade fertilizer mixtures as the following illustration will show:

In a fertilizer plant recently a considerable tonnage of several high-grade mixtures were made on special formulas using acid phosphate, blood, tankage, cotton seed meal, and sulfate of potash. The usual laboratory practice at this plant in the case of mixed fertilizers is to grind the sample to pass 20 mesh. The results on several of these mixtures, were so far from the guaranteed basis as to clearly indicate something radically wrong. An examination revealed considerable segregation during the sampling and while weighing out the portions for analysis. Before weighing the sample was carefully mixed, spread out in a thin layer and a small portion taken from a number of places. From the wild results obtained it was concluded that the mixtures were too coarsely ground to permit uniform mixing and the weighing of uniformly average samples. Other portions of the same sample were then taken and ground to pass 40 mesh. The results follow:

	Ammonia	Available P ₂ O ₅	Potash
20 mesh	3.69	6.47	3.80
40 "	3.91	7.19	3.42
20 mesh	4.88	7.98	6.59
40 "	5.10	7.93	5.13

The above work was done by Mr. R. D. Caldwell,

Atlanta, Ga., and only confirms again recently similar former experiences and further suggests a reason for the discrepancies in the results reported on the mixed fertilizer samples for this year and last. The same will apply in some degree to the meal samples as well and while the segregation may be much less than in case of fertilizer samples, the principle is the same and the error will be greater in case of samples containing the greatest amount of coarse and fine material.

Except when in some laboratories a sample becomes wormy or covered with considerable mould, while in other laboratories the same sample is not so affected, the differences in the portions of the check meal samples sent to the various collaborators are believed to be very slight. This opinion is confirmed by the fact that certain of the collaborators almost invariably report results within 0.02 to 0.03% of the accepted average. For the entire meal series of 40 samples last year Mr. R. D. Caldwell, with the best record for ammonia work, finished with an average difference of less than 0.02% from the accepted average with the maximum discrepancy for any one sample of 0.04%.

Similar excellent results have been reported by several other collaborators in the check meal work both for last year and also this year. The following is a summary of the standing of the four leaders in each set of ten meal samples:

Four Leading Analysts for Each Series

	Max. Aver.		Discrepancy		Max. Aver.		Max. Aver.	
	Max.	Aver.	Max.	Aver.	Max.	Aver.	Max.	Aver.
First 10 samples	0.04	0.016	0.05	0.016	0.06	0.019	0.06	0.022
Second 10 samples	0.03	0.012	0.03	0.014	0.04	0.016	0.03	0.017
Third 10 samples	0.03	0.014	0.03	0.015	0.03	0.016	0.03	0.018

In the above the leader in the First Series of 10 samples is not the same as in the Second Series, etc. Each set of 10 is taken separately in the above without respect to the identity of the leaders.

These results as well as those of the leaders last year surely indicate that the samples must be very uniform.

From the replies to the questionnaire it is noted that:

First: All but three collaborators used sulfuric acid as standard; from N/14.01 to Normal.

Second: Most laboratories use more than one method for standardizing this solution.

Third: All but one collaborator uses caustic soda for the standard alkali; from N/14.01 to N/2.

Fourth: All but six collaborators remove CO₂ from the standard alkali and all but six take at least some precaution to prevent further absorption of CO₂. Several use only the precaution of keeping solution in tightly stoppered bottles. Most of the others use a trap such as soda lime or caustic soda to prevent absorption of CO₂ from air. One uses a layer of kerosene (previously saturated with alkali) on the alkali solution.

Fifth: Methyl red seems to be the favorite indicator. Ten use this indicator, five use cochineal, six use sodium alizarin sulfonate, one methyl orange, one congo red, one both methyl red and sodium alizarin sulfonate.

Sixth: All but one collaborator at least checks the calibration of his burettes (unless using standard). Several use standard burettes only (U. S. Bureau of Standards or Germans Standard), and others use both standard burettes and those of ordinary make which they have checked.

The Committee recommends that in order to secure greater uniformity in procedure and in results the following be considered, viz. that—

First: The Sodium Carbonate be employed as a standard by the method described above and the value 99.90% be tentatively accepted.

Second: The Ammonium Sulfate be employed as a standard by the method described above and the value 25.68% ammonium be tentatively accepted.

Third: The standard acid solution be checked by the gravimetric method, by the sodium carbonate and the ammonium sulfate together with other standards desired.

Fourth: The complete ammonia routine be checked occasionally by the ammonium sulfate standard.

Fifth: The alkali, preferably caustic soda, should be prepared free from CO₂. This may be con-

TABLE No. 1 ANALYSES OF A. O. C. S. STANDARD REAGENTS

No.	Na ₂ CO ₃	Ammonium Sulfate			Standardized by	Removed Absorption Preventors			Indicator
		(1) MgO	(2) Digestion	(3) Added to Blank		Co ₂	Preventors		
55	99.63%	25.63%	25.70%	25.69%	H ₂ SO ₄ BaSO ₄	Yes	CaCl ₂ (?) tubes		Cochineal
5	99.72	25.76	25.68	25.66	H ₂ SO ₄ BaSO ₄	Yes	Conc. KOH trap		Methyl red
6	99.85	25.69	25.63	25.65	 Na ₂ CO ₃ &NH ₄ Cl	Yes	Conc. NaOH trap		Methyl red
8	99.99	....	*25.85	25.78	HCL Na ₂ CO ₃ &AgCl	Yes	Soda Lime		Methyl red
74	99.96	25.72	25.71	25.74	H ₂ SO ₄ BaSO ₄ &(NH ₄) ₂ SO ₄	Yes	Soda Lime		Congo red
15	*101.08	*25.56	*25.56	*25.48	(2) HCL AgCl	....	.....		Cochineal
29	100.02	25.63	*25.59	25.62	H ₂ SO ₄ BaSO ₄	No	Soda Lime	(3)	S.A.S. (2)
57	99.89	25.67	25.68	25.64	H ₂ SO ₄ NaOH&KHC ₄ H ₄ O ₆	Yes	Guard tubes		Methyl red
47	100.00	25.69	25.67	25.66	H ₂ SO ₄ Na ₂ CO ₃ to(NH ₄) ₂ SO ₄	Yes	Keep in stoppered bottle		Methyl red
85	*99.58	*25.55	*25.52	*25.50	H ₂ SO ₄ Na ₂ CO ₃ toBaSO ₄	Yes	.....		Methyl red
46	99.93	25.70	25.69	25.69	H ₂ SO ₄ Na ₂ (NH ₄) ₂ SO ₄ &BeOH	Yes	.....	(3)	S.A.S.
11	*99.15	*25.34	*25.37	*25.53	H ₂ SO ₄ HCl, NH ₄ Cl&samples	Yes	No		Cochineal
72	99.83	25.68	25.70	25.67	H ₂ SO ₄ Na ₂ CO ₃ &Fe(SO ₄) (NH ₄) ₂ SO ₄	....	.....		
28	99.97	25.70	25.72	25.75	H ₂ SO ₄ Na ₂ CO ₃ &BaSO ₄	No	Absorption Sol.		Methyl red
25	99.98	25.68	25.67	25.69	H ₂ SO ₄ Na ₂ CO ₃ &BaSO ₄ &(NH ₄) ₂ SO ₄	No	.....		Methyl red
22	99.94	25.68	25.67	25.67	H ₂ SO ₄ BaSO ₄	Yes	Soda Lime		Methyl orange
27	99.88	25.73	25.70	25.70	H ₂ SO ₄ Na ₂ CO ₃ &BaSO ₄	No	.....		Methyl red
66	99.93	25.65	25.67	25.65	H ₂ SO ₄ Na ₂ CO ₃ &(NH ₄) ₂ SO ₄	Yes	Soda Lime		S.A.S.
26	99.68	*25.45	*25.68	25.67	H ₂ SO ₄ BaSO ₄	No	Keep in stoppered bottle		Cochineal
4	99.88	25.67	25.66	25.67	H ₂ SO ₄ BaSO ₄ Na ₂ CO ₃ &NH ₄ Cl	Yes	Soda Lime		Cochineal
41	99.92	25.69	*25.57	25.64	H ₂ SO ₄ BaSO ₄ &(NH ₄) ₂ SO ₄	Yes	Layer if kerosene		S.A.S.
21	99.89	25.67	25.75	25.75	H ₂ SO ₄ BaSO ₄ &(NH ₄) ₂ SO ₄ &Na ₂ CO ₃	Partly	Keep in stoppered bottle		Methyl red
36	99.89	....	25.63	25.64	HCl BeOH&C ₆ H ₅ Kh(CO ₂) ₂	Yes	Conc. NaOH trap		Methyl red
38	99.98	25.64	25.71	25.63	H ₂ SO ₄ BaSO ₄ &(NH ₄) ₂ SO ₄	No	Conc. NaOH trap		S.A.S.
High	100.02	25.76	25.75	25.78					S.A.S.
Low	99.63	25.63	25.63	25.62					S.A.S.
Ave.	99.89	25.68	25.68	25.65					S.A.S.

*Omitted from average (2) Used KOH instead of NaOH (3) S.A.S.=sodium-alizarine-sulfonate

veniently done by preparing a saturated solution using high-grade stick caustic when the sodium carbonate will settle out. The clear solution will be free from CO₂.

- Sixth: A suitable trap bulb containing granulated soda lime or a solution of caustic alkali be employed to prevent absorption of CO₂ from the air. A layer of kerosene will serve the same purpose.
- Seventh: All volumetric glassware should be carefully checked unless Standard apparatus is used.
- Eighth: The reference above to the care required in weighing to secure average portions for analysis be carefully considered and an effort be made to determine to what degree this affects the accuracy of the results obtained.

The Committee desires to thank all who have found it possible to co-operate with us and for the results reported and recommends that the work for next year be perhaps along the line of taking up the study of one other important step in the ammonia work and suggests that perhaps the care required for the weighing of average portions of the sample and the samples ground to different degrees of fineness be investigated in this connection.

COTTONSEED OIL REFINING COMMITTEE REPORT 1921-1922

By H. J. Morrison, Chairman, Proctor & Gamble Co.,
Ivorydale, Ohio

In 1916 Mr. G. Worthen Agee made a report on tests he had conducted using various shapes of paddles. This report was given at the Memphis meeting of the Society of Cotton Products Analysts and published commencing on Page 21 of their proceedings covering that meeting. These tests indicated that the general type of agitator best adapted for check results was a two arm paddle which has been adapted in the Barrow-Agee Refining machine and commonly referred to as the straight Barrow-Agee Paddle. The tests made at that time indicated that for actual results slight inclination of the paddle or slight modification of the shape of the faces of the paddle did not appreciably effect the results obtained in the color or loss when identical rates of agitation were used. If the rate of agitation was varied, however, almost any result was obtained depending on the speed of rotation of the paddle.

The work assigned to the Cotton Seed Oil Refining Committee this year embraced a retesting of this conclusion, together with a survey of the general practice of laboratory refining.

Data was obtained from the Chemists participating in the Co-operative Analytical Program of this Society, covering the details of the paddles and the rate of agitation employed in their tests. This material has been tabulated according to types of paddles used and the speed of agitation.

TABLE I

Type of Paddle

B-A narrow two arm paddle.....	17
B-A wide two arm paddle.....	2
Marine propeller type paddle.....	4
Assorted Special types of paddles.....	4
<i>Speed of Agitation</i>	
Greater than 300 R.P.M.....	6
250-300 R.P.M.....	7
200-250 R.P.M.....	7
150-200 R.P.M.....	5
100-150 R.P.M.....	2

A study of the analyses reported, compared with the

type and speed of agitation, indicated that the best average results using the type of paddle designated as the B-A narrow two arm paddle were obtained when the rate of agitation used was near 250 R. P. M. A more rapid agitation tended to lower the loss in the refined oil while the color was not quite as good. With slow agitation the reverse was the case. Seventy per cent of the laboratories reporting favored a slowing down of agitation toward the end of the refining and three-fourths of the users of the B-A paddles used this principle.

In order to establish if this practice was essential a series of tests were made on several oils. The practice was to take two parallel samples and refine one using one speed (250 R. P. M.) throughout the refining and with the other to start at the same rate but to cut the rate down (to 100 R. P. M.) after a definite period of time and heating. The results in most cases were found to be so close that they were within the accuracy of the refining. The oil which gave the widest range of results was submitted to six other laboratories and the analyses reported checked original results very well. Only the two modifications of one type of paddle were used as the laboratories that were expected to use a different type of agitator failed to report their results. Data for these experiments will be found in Table II. All parties reported a better condition of the foots for the agitation which was slowed down, but color and loss after the settle and cooling were as good checks in all cases but one, as could be expected.

The effect of a difference in the inclination of the face of the paddle was tested at the same time as the preceding tests were made. No advantage was found in the oils investigated in favor of either the straight paddle or the inclined paddle. Data bearing on this subject is contained in Table II.

TABLE II

	F.F.A	Color	Loss	Agitation	Paddle
1. 2.5 —2.4		7.3	7.6	250 R.P.M.	Inclined
		7.3	7.4	250 100	Inclined
		7.4	7.8	250 100	Straight
		7.3	7.8	250 R.P.M.	Straight
2. 1.7 —1.8		7.2	7.8	250 R.P.M.	Inclined
		7.4	7.8	250 100	Inclined
		7.2	7.6	250 100	Straight
		7.2	7.8	250 R.P.M.	Straight
3. 2.6 —2.5		7.6	7.6	250 R.P.M.	Inclined
		7.4	7.4	250 100	Inclined
		7.2	7.6	250 100	Straight
		7.4	7.6	250 R.P.M.	Straight
4. 2.65—2.4		7.7	7.95	250 R.P.M.	Inclined
		7.7	7.95	250 100	Inclined
		7.7	7.86	250 100	Straight
		7.4	7.8	250 R.P.M.	Straight
5. 3.7		6.3	6.0	250 R.P.M.	Inclined
		6.4	6.6	250 100	Inclined
		6.3	6.8	250 100	Straight
		6.5	5.6	250 R.P.M.	Straight

This table represents a single oil tested by five different men who were given the same instruction for the refinings. It is interesting to note the change in free fatty acid content of this oil. Before shipping all were tested carefully and found to check at 1.8% F.F.A. The two free fatty acid values recorded for each group are the free fatty acids by the Brine method and the alcohol method.

In Table III will be found refining analyses of five oils of free fatty acid content from 1.2 to 3.1, showing no practical difference in effect between the straight and inclined paddles or between the continuous speed and the decreasing speed of agitation.