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DETERMINATION OF THE REASONABLE OR PERMISSIBLE MARGIN OF ERROR IN DISPENSING.

BY MARVIN J. ANDREWS.

TABLE VI.—SUMMARY OF RESULTS.

Prescription Number.	Average S. D.	Number of Batches of Powders Falling within			Percentage of Batches of Powders Falling within		
		1 × S. D.	2 × S. D.	3 × S. D.	1 × S. D.	2 × S. D.	3 × S. D.
1	0.345	14	16	.	46.66	53.33	...
2	0.185	16	14	.	53.33	46.66	...
3	0.525	16	14	.	53.33	46.66	...
4	0.574	16	13	1	53.33	43.33	3.33
5	0.696	17	12	1	56.66	40.00	3.33
6	0.294	17	10	3	56.66	33.33	10.00
7	0.186	17	13	.	56.66	43.33	...
8	0.228	35	23	2	58.33	38.33	3.33
9	0.523	35	19	8	55.00	31.66	13.33
10	0.526	29	31	.	48.33	51.66	...
11	0.185	38	20	2	63.33	33.33	3.33
Totals		248	185	17	55.11	41.11	3.77

An examination of the table shows that 96.22 per cent (55.11 per cent + 41.11 per cent) of a total of 450 batches of powders filled fall within twice the standard deviation for weight. So far as the prescriptions used in these tests are concerned, therefore, this deviation might well be taken as defining the limit for reasonable or permissible error.

CAPSULES.

Capsules are prepared in much the same way as powders, hence the possibilities to err may be expected to be the same. This is demonstrated to be true by the results of the tests reported herein. The preparation of capsules, however, presents an additional opportunity to err in that the bulk material must be filled into the capsules. In some instances, a division of the

bulk material is effected by one of the methods employed for powders before filling into the capsules, but in the majority of cases, the capsules are filled directly from the bulk material, especially where the latter is a powder. The *modus operandi* of filling is, therefore, an important factor in this connection. As in the case of powders, a variety of procedures for preparation has been suggested. For the purposes of this study, however, only those methods generally employed in actual practice were used. They are as follows:

    1. Filling directly from the bulk material, which is usually accomplished by repeatedly pressing the smaller shell, or body of the capsule, into the material until filled. In the case of non-adhesive powders, the material is pushed into the shell with a spatula.

    2. Filling as described above after dividing the bulk material by the blocking method described under powders.

    3. Filling by weight, which consists of packing the material into the capsule until the desired weight is attained.

    In this series of tests, 8 different prescriptions were filled. As in the case of powders, they were selected with a view to determining not only the frequency and magnitude of error traceable to the principal operation involved, but also the extent to which other factors contributed to the total.

No. 12.

Hydrarg. Chlor. Mit.	gr. ii
Lactos.	gr. iv
M. et ft. caps. No. 1	
D. t. d. No. viii	
Sig: One every 15 min.	

No. 13.

Ext. Gentian.	Ði
Ext. Nuc. Vom.	
Ext. Hyoscy. aa.	gr. iv
Ft. caps. No. viii	
Sig: One every 4 hrs.	

No. 14.

Phenyl. Salicyl.	
Acetphen.	
Camph. Monobrom. aa.	gr. xii
Quin. Sulph.	Ði
Ft. caps. No. xv	
Sig: One every 3 hrs.	

No. 15.

Ol. Menth. Pip.	gtt. $^1/_{16}$
Sod. Salicyl.	gr. v
Ft. caps. No. i	
D. t. d. No. xvi	
Sig: One capsule every 3 hrs.	

No. 16.

Pulv. Capsic.	gr. v
Phenyl. Salicyl.	ʒi
Quin. Sulph.	gr. x
M. et ft. caps. No. xii	
Sig: One capsule t. i. d.	

No. 17.

Strych. Sulph.		
Arsen. Triox.	aa.	gr. i
Quin. Sulph.		
Carbo. Lig.	aa.	ʒss
Ft. caps. No. xxiv		
Sig: A capsule t. i. d.		

No. 18.

Ext. Bellad. Fol.		
Ext. Cannab.	aa.	gr. i
Acetphen.		
Acetanil.	aa.	gr. xxiv
M. et div. in caps. No. xii		
Sig: One capsule every 3 hrs. p. r. n.		

No. 19.

Cret. Præp.	ʒi
Mag. Oxid.	ʒi
Phenolphthal.	gr. iv
Ft. caps. No. xii	
Sig: One t. i. d.	

PRESCRIPTION NO. 12.

    Prescription No. 12, the first of the capsule prescriptions worked upon, was filled by the same group of students that filled prescription No. 1 for powders, both being filled during the same laboratory period. In both instances, the students were unaware that the prescriptions were to be examined in any manner other than that regularly employed in the laboratory. These prescriptions were examined for errors in weight, and 10 batches selected at random from the 30 batches of 8 capsules each were assayed for calomel content. The degree of accuracy attained is shown in the following tables:

TABLE VII.—PRESCRIPTION No. 12 (CORRECT WEIGHT OF EACH CAPSULE = 6 GRAINS).

Batch No.	Weight of Each Capsule in Grains.								Total Wt. in Grains.	Av. Wt. in Grains.	S. D.[1]
	1.	2.	3.	4.	5.	6.	7.	8.			
1	5.875	5.875	6.000	6.125	6.000	6.000	6.125	5.875	47.875	5.984	0.075
2	5.875	6.000	6.000	6.125	6.000	6.125	6.125	5.750	48.000	6.000	0.124
3	6.500	6.375	6.250	6.500	6.125	6.000	7.000	5.750	50.500	6.310	0.353
4	5.875	6.625	6.375	6.000	5.750	5.875	7.000	5.625	49.500	6.197	0.451
5	5.875	5.750	6.000	6.125	5.750	5.875	6.250	5.625	47.250	5.906	0.195
6	5.875	5.750	5.625	6.000	5.750	5.875	6.375	5.625	46.875	5.859	0.228
7	5.875	5.875	5.875	5.875	6.000	5.875	5.125	5.750	47.250	5.906	0.103
8	6.125	6.375	5.875	6.000	6.250	5.750	6.000	5.750	48.125	6.015	0.211
9	5.625	5.750	5.875	6.000	6.000	6.000	6.125	4.500	45.875	5.734	0.440
10	6.000	6.000	6.250	6.500	6.375	6.250	6.500	6.000	49.875	6.234	0.201
11	5.875	6.000	5.875	6.000	6.125	6.000	6.250	5.875	48.000	6.000	0.124
12	6.125	6.000	6.250	6.500	6.375	6.250	6.500	6.125	50.125	6.265	0.170
13	6.250	6.125	6.125	6.000	5.750	6.000	6.250	5.250	47.750	5.968	0.310
14	6.000	6.000	6.000	5.875	6.125	6.125	6.125	5.000	47.250	5.906	0.352
15	5.500	6.375	5.875	6.250	6.000	5.875	6.125	5.750	47.750	5.968	0.263
16	6.500	6.000	6.125	5.750	6.125	6.000	5.875	6.125	48.500	6.063	0.207
17	6.250	6.250	6.375	5.875	6.000	6.125	6.625	5.625	49.125	6.140	0.295
18	6.500	5.500	5.750	5.750	5.759	6.250	6.500	5.125	47.125	5.891	0.456
19	6.125	6.250	6.250	6.375	5.750	6.000	5.875	6.000	48.625	6.078	0.197
20	5.750	6.250	6.000	6.125	6.125	6.000	6.375	5.250	47.875	5.984	0.327
21	5.875	6.125	6.125	6.250	5.750	5.875	6.250	6.375	48.625	6.078	0.206
22	6.000	5.750	6.000	5.750	6.125	6.000	6.250	6.125	48.000	6.000	0.165
23	6.375	6.250	6.125	5.625	6.000	5.500	5.875	5.500	47.250	5.906	0.317
24	5.500	6.500	5.625	5.875	6.250	6.125	6.000	6.000	48.875	5.984	0.302
25	5.250	6.125	5.750	6.000	5.875	6.250	6.500	5.125	46.875	5.859	0.443
26	5.750	5.875	5.875	6.250	6.125	6.125	6.250	5.375	47.625	5.953	0.278
27	6.375	5.750	6.000	6.250	6.000	6.125	6.375	5.125	48.000	6.000	0.385
28	5.625	5.875	5.750	5.500	6.000	5.500	6.000	5.375	45.625	5.703	0.224
29	5.875	6.000	6.000	6.000	6.000	6.000	6.125	5.500	47.500	5.937	0.176
30	5.750	5.625	5.875	5.875	5.750	5.875	6.000	5.375	46.125	5.766	0.181

[1] Av. S. D. = 0.258, which is equivalent to an average deviation from the theoretical of 4.30%.

TABLE VIII.—PRESCRIPTION No. 12 (CORRECT PERCENTAGE OF CALOMEL = 33.33).

Batch No.	Per Cent of Calomel in Each Capsule.								Average Per Cent.	S. D.[1]
	1.	2.	3.	4.	5.	6.	7.	8.		
1	34.31	33.80	34.46	33.46	33.08	34.57	32.51	35.23	33.93	0.980
2	34.71	32.65	28.34	32.65	28.34	33.32	33.35	34.32	32.21	2.310
3	34.23	33.30	29.38	33.75	31.39	25.26	29.86	30.59	30.97	2.540
4	33.27	34.00	33.12	33.86	33.15	33.25	33.36	33.37	33.42	0.306
5	28.90	29.20	28.83	28.82	28.69	30.44	30.40	31.08	29.55	0.878
6	35.27	36.05	36.08	35.18	34.93	35.06	36.92	38.82	36.04	1.220
7	33.28	32.64	33.75	34.75	33.09	32.61	34.04	34.46	33.58	0.753
8	31.44	31.00	31.08	33.15	29.19	31.15	30.90	32.26	31.27	1.060
9	36.08	36.67	36.45	35.76	37.39	35.55	36.92	34.49	36.16	0.854
10	32.00	33.50	33.75	32.89	32.50	33.25	33.35	33.65	33.11	0.568

[1] Av. S. D. = 1.15, which is equivalent to an average deviation from the theoretical of 3.44%.

With respect to the weight of the capsules filled Table VII shows the average standard deviation to be 0.258 grains, or 4.30% of the prescribed amount. Sixteen of the 30 batches filled fall within the average S. D. and the remaining 14 fall within twice the average S. D.

In the case of the calomel content, the average standard deviation amounts to 1.147 per cent based on a theoretical calomel content of 33.33 per cent. Seven of the 10 batches fall within the average S. D. and the remaining 3 fall within twice the average S. D. The comment made under the prescription for calomel powders applies equally as well in this instance.

<div align="center">PRESCRIPTIONS NOS. 13–19.</div>

The remaining 7 prescriptions were only examined for errors in weight. Before giving them out to be filled, the students were instructed as to the method to be followed, and they were told that their work would be checked for accuracy.

The extent to which each of the following factors contributed to the total error is shown in Tables IX and X: Nature and number of ingredients, number of capsules in each batch, amount of material in each capsule and *modus operandi* of filling.

<div align="center">TABLE IX.—STANDARD DEVIATION OF PRESCRIPTIONS NOS. 13–15.</div>

Batch No.	No. 13.	Prescriptions. No. 14.	No. 15.
1	0.260	0.296	0.255
2	0.222	0.268	0.405
3	0.408	0.280	0.330
4	0.255	0.346	0.196
5	0.148	0.270	0.170
6	0.247	0.097	0.302
7	0.401	0.254	0.223
8	0.240	0.348	0.211
9	0.152	0.167	0.192
10	0.386	0.466	0.206
11	0.411	0.357	0.176
12	0.404	0.154	0.338
13	0.348	0.422	0.220
14	0.168	0.394	0.264
15	0.178	0.408	0.357
16	0.327	0.464	0.344
17	0.325	0.261	0.376
18	0.108	0.328	0.337
19	0.257	0.103	0.260
20	0.434	0.406	0.346
21	0.088	0.374	0.264
22	0.211	0.391	0.204
23	0.430	0.478	0.356
24	0.410	0.425	0.175
25	0.356	0.151	0.384
26	0.153	0.220	0.303
27	0.192	0.414	0.383
28	0.388	0.456	0.166
29	0.396	0.437	0.374
30	0.273	0.334	0.207
Av. S. D. =	0.286	0.326	0.277
Av. % =	8.17	8.73	5.47

The extent to which the *modus operandi* of filling capsules affects the final error is comparable to that observed in the case of powders; and as in the case of powders, the method in which the individual doses are divided off by weighing is the most accurate. This is clearly shown in the results obtained for prescription No. 16 in which 22 of the 40 batches of capsules filled fall within the average S. D. and the remaining 18 within twice the average S. D.; and in prescription No. 17, in which 25 of the 40 batches of capsules filled fall within the average S. D. and the remaining 15 within twice the average S. D.

TABLE X.—STANDARD DEVIATION OF PRESCRIPTIONS NOS. 16–19.

Batch No.	No. 16.	No. 17.	No. 18.	No. 19.
		Prescriptions.		
1	0.256	0.261	0.138	0.522
2	0.506	0.234	0.348	0.145
3	0.215	0.307	0.153	0.332
4	0.147	0.325	0.246	0.668
5	0.454	0.212	0.419	0.395
6	0.258	0.118	0.130	0.403
7	0.144	0.235	0.180	0.669
8	0.236	0.247	0.294	0.068
9	0.305	0.259	0.154	0.324
10	0.088	0.235	0.271	0.373
11	0.464	0.225	0.141	0.411
12	0.046	0.254	0.200	0.645
13	0.104	0.195	0.274	0.593
14	0.252	0.144	0.415	0.395
15	0.080	0.209	0.263	0.148
16	0.213	0.346	0.292	0.320
17	0.421	0.263	0.322	0.141
18	0.483	0.347	0.204	0.218
19	0.316	0.128	0.281	0.161
20	0.374	0.275	0.410	0.359
21	0.114	0.416	0.129	0.038
22	0.072	0.382	0.332	0.310
23	0.374	0.299	0.293	0.642
24	0.054	0.401	0.360	0.621
25	0.438	0.207	0.229	0.142
26	0.443	0.405	0.405	0.636
27	0.061	0.267	0.339	0.510
28	0.325	0.427	0.366	0.204
29	0.207	0.330	0.294	0.524
30	0.210	0.416	0.413	0.518
31	0.314	0.260	0.322	0.512
32	0.425	0.243	0.130	0.552
33	0.318	0.218	0.342	0.609
34	0.207	0.461	0.134	0.484
35	0.243	0.454	0.421	0.791
36	0.252	0.275	0.417	0.574
37	0.350	0.108	0.335	0.528
38	0.117	0.242	0.144	0.196
39	0.284	0.475	0.416	0.625
40	0.135	0.204	0.195	0.448
Av. S. D. =	0.257	0.283	0.279	0.419
Av. % =	4.11	10.95	6.69	4.05

The method of blocking and dividing is next in accuracy, as shown by the results obtained for prescription No. 13. In this instance, 16 of a total of 30 batches fall within the average S. D., and the remaining 14 fall within twice the average S. D. The results obtained for prescription No. 15 are similar in character and furnish added proof of the correctness of the above statement.

The method in which the capsules are filled by packing directly from the bulk material is the least accurate of the methods tested. This is shown to be true by the results obtained for prescription No. 14 in which case 12 of a total of 30 batches fall within the average S. D., while 18 fall within twice the average S. D. Further proof for the correctness of this statement is furnished by the results obtained for prescription No. 18.

The nature of the ingredients of the prescription is a factor responsible for a part of the total error.   This is shown by the results obtained for prescriptions Nos. 13 and 15.

Likewise, the number of ingredients is a factor to be reckoned with.   The greater the number of ingredients, the greater the number of weighings and transfers, each of which presents opportunities to err.   This is shown to be true by results obtained for prescriptions Nos. 12, 13, 14 and 18.

The magnitude of the error made seems to depend to some extent on the number of capsules in each batch.   Apparently, the greater the number of capsules filled, the greater the chance for error.   This is shown by results obtained for prescriptions Nos. 12, 13, 14, 15, 16 and 18.

The effect of weight of the contents of individual capsules on the final error is of the same general order as that observed in the case of powders.   Likewise, as in the case of powders, the average S. D. increases as the weight increases, whereas the percentage deviation from the theoretical amount decreases, correspondingly.   This is shown in the table immediately following.

TABLE XI.—EFFECT OF WEIGHT OF INDIVIDUAL CAPSULES ON STANDARD DEVIATION.

Prescription Number.	Theoretical Weight of Each Capsule in Grains.	Average Standard Deviation.	Percentage Deviation from the Theoretical.
17	$2^1/_2$	0.283	10.95
13	$3^1/_2$	0.286	8.17
15	5	0.277	5.47
16	$6^1/_4$	0.257	4.11
19	$10^1/_3$	0.419	4.05

TABLE XII.—SUMMARY OF RESULTS.

Prescription Number.	Average S. D.	Number of Batches of Capsules Falling within		Percentage of Batches of Capsules Falling within	
		1 × S. D.	2 × S. D.	1 × S. D.	2 × S. D.
12	0.258	16	14	53.33	46.66
13	0.286	16	14	53.33	46.66
14	0.326	12	18	40.00	60.00
15	0.277	16	14	53.33	46.66
16	0.257	22	18	55.00	45.00
17	0.283	25	15	62.50	37.50
18	0.279	18	22	45.00	55.00
19	0.419	20	20	50.00	50.00
Totals		145	135	51.76	48.21

The results obtained with prescriptions calling for capsules are summarized in Table XII.   It will be observed that they are almost identical with those obtained for powders, so that further comment is unnecessary.   Twice the standard deviation was suggested as the limit of reasonable or permissible error for the preparation of powders, and since all batches of the capsules prepared fall within this limit, the acceptance of the same standard would appear to be justified.

(*To be continued*)

METHYLATED SPIRIT DRINKING IN SCOTLAND.

The magistrates of Glasgow resolved to suggest to the Secretary of State for Scotland that legislation should be introduced to have the sale of methylated spirits more strictly controlled than it is to-day.   The object in view is the repression of methylated spirits drinking, which has come to be a very great evil in the city.

On the motion of Bailie John Henderson, the magistrates unanimously adopted a suggestion made by the Chief Constable, and instructed the Town Clerk to draft representations to lay before the Secretary of State for Scotland in favor of legislation under which methylated spirits would be included in the category of a poison within the meaning of the Dangerous Drugs Act, or that at all events the right of sale would be vested only in fully qualified chemists.