REPORT OF THE COMMITTEE ON THE STANDARDISATION OF LABORATORY GLASSWARE.

[The following Report has been received from the Committee on which the Society of Glass Technology had a representative.]

THE suggestion that the Society of Chemical Industry should take up the question of the standardisation of laboratory glassware was made on the occasion of the reading of a paper on "Scientific Glassware" by Dr. Morris Travers at the Annual General Meeting of the Society at Bristol in July, 1918 (see *Journal of the Society of Chemical Industry*, Vol. **37**, p. 235 T). Dr. Travers subsequently brought the matter before the British Chemical Ware Manufacturers' Association, which approved of the suggestion that the Society should take the initiative in the matter and assured Dr. Travers of its heartiest co-operation. A letter was received later from the Controller of Optical Munitions and Glassware Supply of the Ministry of Munitions, supporting the suggestion that standardisation should be effected as early as possible, and offering the services of a member of his technical staff to discuss the best methods of procedure to be adopted. On October 21st, 1918, Mr. F. W. Branson, of Messrs. Reynolds and Branson, Ltd., of Leeds, read a paper on "Some Aspects of the Chemical Glassware Industry" (including Standardisation), before the Yorkshire Section of the Society. (See *J.S.C.I.*, Vol. **37**, p. 337 T.)

At the meeting of Council of the Society held on October 24th, the President proposed that a committee should be appointed to confer with other interested bodies on the subject, with a view to cutting down the supply of various classes of apparatus to a certain number of standard sizes, and he intimated that the Société de Chimie Industrielle was prepared to co-operate in the matter. This proposal was agreed to, and the following were appointed to serve on the Committee:—Sir Robert Hadfield, Mr. K. Chance, Sir Herbert Jackson, Dr. C. Carpenter, Mr. W. F. Reid, Dr. Travers (convener), with the President (Prof. Louis) and the Hon. Treasurer (Mr. D. Lloyd Howard) *ex officio*.

At the first meeting of the Committee, held on November 20th, the subject was discussed in a preliminary manner, and it was strongly felt by the members present that it was necessary in the first instance to obtain the views of manufacturers, users, and the retail trade. The Committee therefore asked the Council to authorise it to obtain the co-operation of representatives of these bodies, and the Council at its meeting in November authorised the Committee to co-opt other members and to call in the assistance of associations or individuals at its discretion. The Committee, acting on this authority, has since co-opted the following members:—Mr. Arnold Stevenson (Glassware Supply, Ministry of Munitions), Mr. V. Stott (National Physical Laboratory), Dr. J. J. Fox (Government Laboratory), Mr. J. R. Griffin (British Laboratory Ware Association), Mr. F. W. Branson of Leeds, Mr. D. P. Berridge and Mr. F. A. Beesley (Science Masters' Association), Mr. G. F. Baker (British Lamp-blown Scientific Glassware Manufacturers' Association), Dr. S. Rideal (Society of Public Analysts), Mr. T. A. Moore (India Office), Mr. G. A. Mallinson, interim (Pharmaceutical Society), Dr. W. E. S. Turner (Society of Glass Technology), Lt.-Col. D. Harvey (War Office). Mr. Kenneth M. Chance, owing to business engagements, has had to resign his membership of the Committee.

In dealing with each class of apparatus the Committee in the first instance set to work to collect information as to the varieties and sizes manufactured before and during the war, and statistics of sales by the distributing firms, which gave the only definite indication of the relative demand for different articles. In the case of beakers the Committee also endeavoured to obtain the views of users as to the forms and sizes which should be manufactured, by addressing an inquiry to certain of the more important professional bodies, but the answers which they received were so indefinite that the method was not followed up. As it frequently happened that important information with regard to a particular kind of glassware was received when the inquiry relating to it appeared to have almost reached a conclusion, the work of the Committee has been somewhat prolonged.

In making its recommendations the Committee has had due regard for the fact that much money had already been spent on moulds, and that it would be quite useless to advise the manufacturers to replace existing moulds by new ones, without very strong reasons for doing so.

All dimensions and capacities are given in metric measure, which the Committee considers should be more uniformly adopted. This point is important, if an export trade in scientific glassware is to develop in connexion with such countries as South America.

CYLINDRICAL BEAKERS.

The study of the problems connected with this section of the subject occupied a considerable amount of time. Detailed information as to the sizes manufactured by British, German, and Austrian houses was laid before the Committee, and also statistics as to the relative numbers of the various sizes of beakers sold by the principal dealers in this country. Every endeavour was made to ascertain the views of users as to the forms and sizes of beakers most commonly employed in scientific and analytical laboratories. Suggestions made by both manufacturers and dealers with a view to cheapening production and distribution had also to be considered.

So extensive was the information which was ultimately collected that it was necessary to appoint a Sub-Committee to deal with it. On the report of the Sub-Committee the Committee decided to make certain definite recommendations which are detailed below:—

It appeared that three kinds of beakers were on the market:—(*a*) A squat form with or without spout, (*b*) a medium form, (*c*) a tall form. It was generally agreed that two forms would meet all requirements.

The thicknesses of the walls of beakers should approximate to those set down in the table. It was decided that no advantage is to be gained by specifying as the nominal capacity of a beaker the approximate content when filled to a definite distance from the top, because in analytical practice a beaker is usually half filled with liquid, but that the capacity of a beaker should be specified as the approximate content when filled to the brim with liquid. The total height, and the external diameter immediately above the curve at the base should also be catalogued. From the point of view of the user the taper in beakers should be slight, otherwise precipitates tend to settle on the walls; a slight taper is also desirable from the manufacturing point of view, so that the article when blown may be easily freed from the mould. For storage purposes the tapering of beakers is an advantage, for the greater the taper, the greater is the number of beakers of a single size which can be stored in a bin. It was decided that a taper of 1 in 20 on the diameter should be adopted.

From the manufacturing point of view it is important that the series of beakers should be so designed that corresponding numbers of the squat and tall beaker series should have identical diameters at the base, so that a tall beaker spoiled in the process of manufacture could be cut down to the height of the squat beaker. This principle, which had been employed by Bohemian manufacturers and by one English firm, was adopted by the Committee.

While it was of equal advantage to manufacturers, dealers, and users, to reduce the number of beakers in the series, in arriving at a decision as to the series which should be adopted, close attention had to be paid to the following points:—

(*a*) The series must contain those sizes which are in most common use. (*b*) The space between the beakers must be such as to allow of packing material being placed between adjacent members when the beakers are nested. The space between the beakers must increase with increase in diameters of the beakers. (*c*) When the beakers are nested the rim of each beaker must rest on the rim of the next in series. (*d*) The general appearance of the beakers when nested in series must not be left out of account.

It was finally decided to adopt the following series of diameters:—26, 30, 35, 41, 48, 56, 65, 75, 86, 98, 111, 125, 140, 156, 173 mm.

Finally, the ratio of the height to the diameter of the beakers in the two series was considered, and after reviewing the information which had been collected with regard to existing series, it was decided to adopt the values 1·37 and 2·0 as the values of the ratio, overall height to diameter near base, for squat and tall series respectively.

TALL SERIES.

Ratio $\frac{\text{Height}}{\text{Diam.}} = \frac{2}{1}$ Taper = 1 in 20.

A No.	B External diam. near base, mm.	C Thickness of walls, mm.	D Overall height, mm.	E Approximate capacity to level of brim, c.c.	No.
0	26	0·5	52	25	0
1	30	0·5	60	40	1
2	35	0·5	70	60	2
3	41	0·5	82	100	3
4	48	0·75	96	160	4
5	56	0·75	112	250	5
6	65	0·75	130	400	6
7	75	0·75	150	600	7
8	86	1·00	172	1000	8
9	98	1·00	196	1500	9
10	111	1·00	222	2000	10
11	125	1·00	250	3000	11
12	140	1·25	280	4000	12
13	156	1·25	312	6000	13

Squat Series.

Ratio $\frac{\text{Height}}{\text{Diam.}} = 1{\cdot}37$ to 1. Taper = 1 in 20.

A No.	B External diam. near base, mm.	C Thickness of walls, mm.	D Overall height, mm.	E Approximate capacity to level of spout, c.c.	No.
1	30	0·5	41	25	1
2	35	0·5	48	40	2
3	41	0·5	56	60	3
4	48	0·75	66	100	4
5	56	0·75	77	160	5
6	65	0·75	89	250	6
7	75	0·75	103	400	7
8	86	1·0	118	600	8
9	98	1·0	134	900	9
10	111	1·0	152	1300	10
11	125	1·0	171	2000	11
12	140	1·25	192	2750	12
13	156	1·25	214	4000	13
14	173	1·25	237	5000	14

The preceding tables give the dimensions of two series of beakers recommended for adoption by the Committee. It is also recommended that the data set down in columns A, B, D, and E be given in price lists and catalogues.

Beaker Flasks and Conical Beakers.

It appeared to the Committee that no advantage would be gained by suggesting that manufacturers should make new moulds for beaker flasks and conical beakers. It recommends, however, that the greatest diameters, the heights, and the total capacities of these articles should be catalogued.

Flasks.

The Committee considers that a flask should hold at least the nominal capacity when filled with liquid to the level of the base of the neck. The nominal capacity and the external diameter of the neck should be catalogued.

The flange of a flask should be turned over sharply, the mouth should not be belled.

It did not appear to the Committee that any material advantage was to be gained by reducing the number of round and flat-bottomed flasks manufactured, except in so far as it might be possible to eliminate one or the other of almost identical sizes such as those corresponding to 100 and 125 c.c., 350 and 400 c.c., 700 and 750 c.c., 1250 and 1300 c.c. The sizes of flasks between 50 and 10,000 c.c., which it considers to be sufficient to meet all requirements, are set down in the following table. Of these flasks, those corresponding to 600, 1250, and 2500 c.c. are retained, as they correspond to the pint, quart, and the 2 quart sizes, and are therefore in demand for certain purposes.

It was suggested to the Committee that if flasks, over a considerable range, had necks of the same diameter, the number of sizes of rubber stoppers which it would be necessary to stock in the laboratory might be considerably reduced. The Committee decided not to adopt the suggestion.

The Committee recommends that as new moulds come to be made, the necks should conform to the following dimensions:—

(*a*) Flat, Round-bottomed and Conical Flasks.

Capacity of flask, c.c.	External diameter of neck, mm.	Capacity of flask, c.c.	External diameter of neck, mm.
50	17	(1250)*	33
100	18	1500	35
150	18	2000	40
200	21	(2500)*	40
250	25	3000	45
350	25	4000*	45
500	27	5000	55
(600)*	27	7500	60
750	29	10,000	65
1000	33		

* Flat and round-bottomed only.

It appears that there is still a demand for the pear-shaped as well as the globular form of flask.

(*b*) Wide-mouthed Flasks with Short Necks.

i. Flat-bottomed flasks, known as CO_2 flasks or extraction flasks.
ii. Round-bottomed flasks, known as bolt heads.

Capacity, c.c.	Diameter of neck, mm.	Capacity, c.c.	Diameter of neck, mm.
50	30	750	50
100	35	1000	55
150	35	1500	55
250	40	2000	60
350	40	3000	60
500	45	5000	65

Flat-bottomed flasks to 500 c.c. capacity only.

In view of the fact that a very considerable number of moulds for the short, wide-mouthed flasks, with flat and round bottoms (known as extraction or CO_2-flasks, and bolt-head flasks respectively), are already in the hands of various manufacturers, the Committee suggests that the manufacturers should confer amongst themselves with a view to eliminating unnecessary sizes at once.

(c) Distillation Flasks.

Capacity, c.c.	Diameter of neck, mm.	Length of neck, mm.
50	12	135
100	15	145
150	17	155
250	20	170
350	20	185
500	23	200

Larger sizes as round-bottomed flasks.

(d) Kjeldahl Flasks.

Capacity, c.c.	Diameter of neck, mm.	Capacity, c.c.	Diameter of neck, mm.
100	22	300	28
200	25	500	30

(e) Conical Filtering Flasks.

The flasks must be well annealed, evenly blown, and thick in the walls, so as to be able to stand exhaustion, and filling with boiling liquid without cracking. The neck of filtering flasks to take rubber stoppers should be turned out sharply and not belled. The tubulure should be so drawn out as to take thick-walled rubber tube 3/16-in. internal diameter. The internal diameter of the neck should be at least:—

Capacity, c.c.	Diameter, mm.	Capacity, c.c.	Diameter, mm.
100	25	1500	40
250 or 300	33	2000	45
500	35	3000	45
750	40	5000	50
1000	40		

Kipp's Apparatus.

The overall height and the diameter of the middle bulb should be listed.

The Committee considers that four sizes corresponding to 85 mm., 105 mm., 125 mm., and 180 mm.; or 250, 500, 1000, and 2000 c.c. should meet all requirements.

FUNNELS.

(*a*) Plain or Fluted Funnels of Thin Glass.

It is of very great importance that funnels should be made so that, in the case of plain funnels, a hardwood cone accurately turned to an angle of 60° will fit into the inside without side play. In the case of ribbed funnels the ribs should be pronounced on the inside.

Funnels should be ground flat on the top.

The stems should either be of parallel bore, or should taper slightly to the point; taper in the reverse direction is objectionable. The point should be ground off at an angle of about 30°.

Though the sizes of funnels are generally catalogued in inches, the Committee suggests that the dimensions should in future be given in millimetres. The series 1, 1½, 2, 2½, 3, 3½, 4, 4½, 5, 6, 8, 10, 12 inches, should be replaced by the series 30, 45, 60, 75, 90, 105, 125, 150, 200, 250, and 300 mm., the number in the series being reduced from 13 to 11, the sizes 3, 3½, and 4 in., which are important, corresponding almost exactly with the sizes 75, 90, and 105 mm.

The following is a summary of the suggested dimensions of funnels:—

Outside diameter across top, mm.	Approximate length of stem, mm.	Approximate external diameter of stem, mm.
30	45	5
45	60	5 to 6
60	75	6 to 8
75	90	8 to 10
90	105	8 to 10
105	120	10 to 12
125	130	10 to 12
150	150	12 to 15
200	165	15 to 20
250	180	20 to 23
300	200	22 to 25

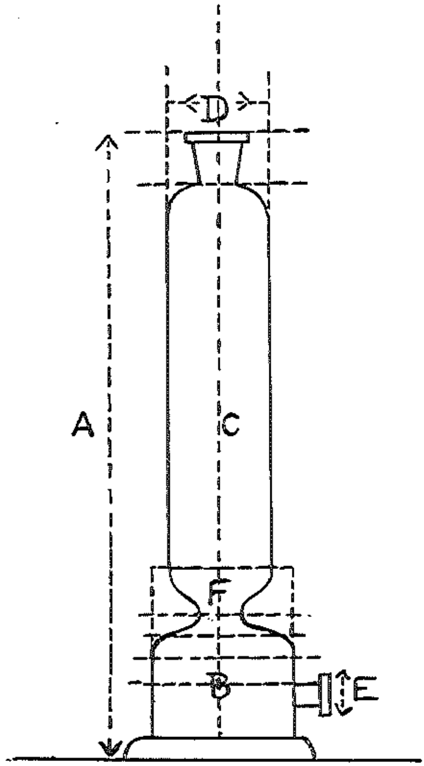
(*b*) Deeply Ribbed Funnels, Pressed.

The following sizes, for which press moulds already exist, were adopted by the Committee:—

7, 9, 11, and 16 cm.

DRYING TOWERS.

The total height and the diameter of the Cylindrical portion should be catalogued. The tubulure at the base should not be less than 15 mm. in diameter at the outer end. The following dimen-



sions of drying towers—from moulds which already exist—are recommended for adoption:—

No.	A	B	C	D	E	F
1	200	45	40	25	15	15
2	250	55	45	30	15	18
3	300	65	50	30	15	18
4	400	90	65	30	15	22

It is important that the internal diameter of the constriction should be less than the minimum internal diameter of the neck.

DESICCATORS.

The catalogued dimension of a desiccator should be the internal diameter of the opening of the container portion of the apparatus.

The dimensions of a desiccator should be such that the depth of the part of the apparatus in which the article or material to be dried is placed should be at least two-thirds of the diameter of the opening.

The ground contact surface between the body of the apparatus and the lid or cover should be at least 15 mm. for 100, 125, and 150 mm. sizes, and 20 mm. for 200 and 250 mm. sizes. In the case of vacuum desiccators, the ground contact surface should not be less than 20 mm. in any case.

The Committee considers that the following variety and sizes of desiccators will meet all requirements:—

Scheibler form (plain, with tubulure in lid, and with tubulure in side), 100, 125, 150, 200, and 250 mm.; Fresenius form, 125 mm.; Hempel form, 150 mm.

ASPIRATORS and WOULFE'S BOTTLES.

The Committee recommends that the diameter and height overall be listed. The vessel should contain at least its nominal volume when filled with liquid to the base of the neck.

The ratio of the diameter to the height to the base of the neck should not be less than 3 to 5.

The taper of the necks and tubulures should be such as to correspond to change in diameter at a rate corresponding to about 1 in 7, so as to allow of stoppering, and to fit corks and rubber stoppers.

In the case of Woulfe's bottles, it is important that the side necks be so placed that a glass tube can pass through the centre of a cork in the neck vertically to the bottom of the bottle.

It is considered that the following sizes will meet all requirements:—

Nominal capacity, c.c.	Minimum internal diameter of necks, mm.	Minimum internal diameter of tubulures, mm.
125*	15	15
250	15	15
500	20	15
1000	25	20
2500	32	20
5000	40	25
7500	40	25
10,000	40	25
15,000	45	25

* Woulfe's bottle only

GRADUATED APPARATUS.

The Committee desires to call attention to the facilities offered by the National Physical Laboratory for the testing of graduated glassware. The Committee has had before it copies of a pamphlet dealing with "Volumetric Tests on Scientific Glassware" issued by the National Physical Laboratory in July, 1918, in which full information relating to the details of these tests is given. Copies of this publication may be obtained free of charge on application to The Director, The National Physical Laboratory, Teddington, Middlesex. The pamphlet deals with Class A Tests, that is, the examination of apparatus in which the highest degree of accuracy is required, and vessels which pass the tests have the Laboratory mark, which is a combination of the Laboratory monogram and the date of test, etched on them. Apparatus submitted for Class A Tests and found to be outside the limits of acceptance for standard apparatus is, if considered of reasonable accuracy for commercial purposes, given the Class B mark. In addition to the Class A tests the Laboratory has now under consideration Class B tests, that is, the examination of apparatus primarily intended to possess only commercial accuracy. It is hoped that it may be possible to complete the final arrangement for these tests in the near future.

(*a*) Pipettes.

The dimensions recommended for single-mark bulb pipettes are given on the next page.

In view of the great divergence in opinion and practice amongst chemists in their methods of using pipettes and burettes it was thought desirable to include in this report brief notes on this subject.

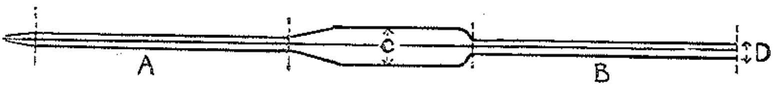
With regard to pipettes, numerous methods of using one mark delivery pipettes have been proposed from time to time; but all may be included in one or other of the two following classes:—

(*a*) Those in which the small quantity of liquid which remains in the jet is allowed to stay there, and

(*b*) Those in which this liquid is ejected, *e.g.*, by blowing down the pipette, or by closing the top of the pipette with one finger and warming the bulb by clasping it with the other hand.

Methods in which the small quantity of liquid which collects in the jet of a pipette when outflow has ceased is allowed to remain there are more reliable than those involving the ejection of this liquid. The latter methods are, therefore, not to be recommended.

With regard to the former methods it is essential in order to obtain the best results to have a perfectly definite order of procedure. Recommendations as to the procedure to be followed are given below. In order to obtain results with pipettes tested at the National Physical Laboratory which shall be in agreement with the values certified, the pipette should be used in accordance with the conditions of test printed on the certificate of corrections. In cases, however, where one is prepared to accept the nominal value of a pipette provided that it is correct within reasonable limits the following method may be used, with pipettes calibrated in accordance with the National Physical Laboratory methods of test, without introducing appreciable errors.



Capacity c.c.	1	2	4	5	10	25	50	75	100
A ... ... mm.	95	100	120	120	190	200	200	200	165
B ... ... mm.	110	115	120	120	160	200	200	200	200
C (int.) ... mm.	5·5 to 6·5	7 to 7·5	10 to 10·5	11·5 to 12	13·5 to 14	17 to 18	27 to 28	30 to 31	35 to 36
D (int.) ... mm.	2	2	3	3	4	5	5	5	7
Distance of mark above bulb, about mm.	25	35	35	35	40	50	50	50	50

The pipette is filled with liquid to a short distance above the mark. Liquid is then run out until the meniscus is on the mark and the outflow is then stopped. The drop adhering to the tip is removed by bringing the tip of the pipette into contact with the surface of the liquid from which it has been filled and then removing it without jerking. The pipette is then held vertically and allowed to deliver with the jet touching the side of the receiving vessel, the vessel being slightly inclined. The pipette is allowed to drain for 15 seconds after outflow has ceased, with the tip still in contact with the side of the vessel, and the pipette itself vertical. On completion of the draining time the vessel is removed from contact with the tip of the pipette, thus removing any drop adhering to the outside of the pipette. To determine the instant at which outflow ceases, the motion of the liquid surface down the delivery tube of the pipette is observed, and the delivery time is considered to be complete when the meniscus comes to rest slightly above the end of the delivery tube. The one-fourth minute draining time is counted from this moment.

The method just described in detail differs from the method of test at present employed at the National Physical Laboratory only in the following particulars:—

(*a*) The pipette is allowed to deliver with the jet continuously in contact with the walls of the receiving vessel instead of using free delivery.

(*b*) At the end of the one-fourth minute drainage time the drop adhering to the pipette is detached against the side of the receiving vessel instead of on the surface of the liquid already delivered.

As stated previously, when a pipette is being used for work in which, if the pipette is accurate within reasonable limits, it is sufficient to accept its nominal volume for delivery as the correct volume delivered, then it is immaterial whether the National Physical Laboratory method is adhered to strictly or the alternative method given above be used. The difference between the results obtained by the two methods is appreciably less than other possible incidental errors. This is assuming, of course, that the pipette was initially calibrated for the above methods of use. If, however, such a pipette is used by methods involving the ejection of the drop of liquid, which in the above methods is allowed to remain in the pipette, the results obtained may differ very appreciably from the volume delivered by the method for which it was calibrated. In view of the fact that more reliable results are obtainable by the methods of using pipettes described above than by injection methods, it is recommended that manufacturers should continue to calibrate pipettes in accordance with the conditions of test specified in the National Physical Laboratory test pamphlet previously referred to. Further, in order to secure uniformity of results it is desirable that users of pipettes should follow the above recommendations as to method of use. In arriving at the conclusions set out above the results of a recent investigation on different methods of using pipettes carried out at the National Physical Laboratory were available to the Committee, and will be published in the near future.

Burettes.

Two of the main sources of error in the use of burettes are:—

(*a*) Change in rate of delivery arising from different manipulation of the tap on different occasions. This causes a variation in the volume of liquid delivered corresponding to a given interval on the burette. (*b*) Change in reading due to drainage of liquid down the walls of the burette.

Quite large errors may arise from these causes and often escape detection in ordinary analytical work, particularly if burettes with quick delivery times are used. By delivery time is meant the time occupied by the outflow of water from the zero graduation mark to the lowest graduation mark when the tap is fully open. The possibility of errors arising from the above causes is reduced to a very considerable extent by using burettes with comparatively long delivery times.

The times of delivery specified by the National Physical Laboratory for burettes submitted for Class A tests are given in table A.

TABLE A.

Length graduated, cm.	Minimum time of outflow, sec.	Maximum time of outflow, sec.
15	30	60
20	40	80
25	50	100
30	60	120
35	70	140
40	80	160
45	90	180
50	100	200
55	110	220
60	120	240
65	130	260
70	140	280
75	150	300

The minimum times of delivery have been so chosen that for tubes of the diameters ordinarily employed for burettes, the rise in the meniscus due to drainage shall not exceed approximately 0·05 mm. in the first two minutes after closing the tap. The maximum times have no physical significance, but merely fix an upper limit in order to avoid the rate of delivery being made intolerably slow.

With burettes conforming with the above limits as to delivery time, the second cause of error mentioned at the outset, viz., change in reading due to drainage, is practically eliminated. The errors introduced by increasing the time of delivery above the natural time of delivery of the burette are also very much smaller than would be the case with burettes calibrated for a quick delivery.

With burettes calibrated for the above delivery times the only demands made upon the user in order to obtain results in agreement with those obtained in testing the burette are:—

(1) The burette should be allowed to deliver with the tap fully

open. (2) The reading should be taken immediately after the required amount of liquid has been run from the burette. (3) The 0 c.c mark of the burette should be taken as the starting point.

The mode of manipulation is thus extremely simple, and makes a minimum demand on the user's time and attention.

It is worth while to consider the above details of manipulation more fully, with a view to possible variations in the course of analytical work.

The first condition should be adhered to as strictly as possible. If, however, the liquid is delivered more slowly, the errors introduced will be much smaller for burettes of the specified times of outflow than for burettes of short delivery time. Moreover, the times of delivery fixed are quite long enough for almost all purposes, and it will rarely be desired to lengthen them still further. It is, of course, not feasible to keep the tap fully open when the end-point of a titration is being approached. The fact that the last cubic centimetre or so is delivered quite slowly is in effect, however, simply an introduction of a short drainage time, and it has been pointed out previously that the delivery times have been so chosen that the rate of drainage is almost negligibly small. Also, in testing burettes the last cubic centimetre is necessarily run out slowly, thus approximating to the conditions of an actual titration. It may also be desirable at times to add the reagent from the burette in small quantities at a time. If this is done by smartly turning the tap fully open and smartly closing it when the required fraction has been added, the total volume thus added, as indicated by the initial and final burette readings, will be in close agreement with the volume delivered by emptying the burette continuously from the initial to the final reading. This again is in virtue of the fact that the delivery times have been chosen sufficiently long. With quick delivery times very different results would be obtained in the two cases. It should further be pointed out that although the proposed delivery times are appreciably longer than those which it is customary to employ, yet by eliminating the necessity of waiting for drainage, the time occupied by a titration is actually shortened in spite of the increased delivery time.

The second condition, given previously, that the reading should be taken immediately after the required amount of liquid has been taken from the burette, may be departed from within reasonable limits (say, two or even five minutes), to suit the convenience of the user. If the third condition is departed from and a reading other than the 0 c.c. mark is taken as the initial reading, only quite small errors will be introduced.

The Committee recommends that burettes should be made with delivery times in accordance with the National Physical Laboratory specifications and used in the manner described above.

The Committee recommends that a detailed account of the work of Mr. V. Stott on the use of pipettes and burettes shall be published in the Society's *Journal*.*

Measuring Flasks.

The Committee calls attention to the dimensions of necks of graduated flasks set down in the pamphlet issued by the National Physical Laboratory.

Measuring Cylinders.

The Committee calls attention to the fact that only in the case in which the body of a measuring cylinder is made from tube is it possible to obtain anything approaching perfect uniformity of internal diameter. In cylinders blown in the mould the internal diameter invariably diminishes more or less sharply towards the bottom, and the walls are often irregular. The length of the bottom of a cylinder blown in a mould corresponding to 1/10 of the nominal capacity should not be graduated, as the readings over this range are likely to be inaccurate.

In reading the level of liquid in measuring cylinders attention is called to the method of observation described by the National Physical Laboratory. Unless proper precautions are taken widely different results can be obtained.

The following dimensions of cylinders are recommended for general use:—

Capacity, c.c.	Diameter, mm.	Height overall, stoppered, mm.	Height overall, unstoppered, mm.	Diameter of foot, mm.
5	13	—	110	35
10	15	—	125	35
25	20	200	200	45
50	24	240	200	50
100	31	290	240	60
250	41	380	330	75
500	52	480	380	95
1000	67	510	440	115
2000	82	610	500	130

Lamp-blown Apparatus.

The Committee considered the possibility of standardising lamp-blown apparatus. It was represented to it that if such pieces of

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apparatus as the Orsat gas-analysis apparatus were standardised, chemists would not experience the difficulty of replacing broken parts which existed at the moment. The Committee, however, was not in a position to undertake the enormous amount of detailed work which the fixing of standards would entail, but suggests that the matter might be taken up by the British Lamp-blown Scientific Apparatus Manufacturers' Association. As no moulds are required in this work the case is somewhat different from that of the mould-blown hollow ware.

[Signed]
MORRIS TRAVERS, *Chairman.*
J. P. LONGSTAFF, *Secretary.*

July 12*th*, 1919.