ANOTHER MODIFICATION OF THE BARNARD-BISHOP STILL

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The writer of this note has used both forms of the still described by Barnard and Bishop.¹ This type of still has many advantages which recommend it for use in a laboratory where a large number of distillations must be made. It allows the use of flasks varying greatly in size and may be placed upon a table close to the wall, allowing the greater part of the table top to be used for other work. The entire apparatus is held upon three vertical pipes and there is no confusion of water- and gas-tubing to litter the table. The burners may be readily turned to one side, raised or lowered. The modified still described herein was constructed for use in running ammonia determinations in water analysis. The changes made

from the old design were intended to give greater rigidity, better arrangements for centering the flames beneath the flasks, and also to allow the use of cooling water under greater pressure.

In the old type of still, a tapped 1 in. iron pipe acted as gas main and support for the burners and flasks. The difficulty of tapping the pipe and threading it accurately made the brass tubes somewhat insecure and rendered it almost impossible to make them lie in the same plane. This pipe is replaced in the new still by one composed of short sections of 1-in. pipe and 1-in. $\times$ 1-in. $\times$ $\frac{1}{2}$ -in. tees. Into the tees ($8\frac{1}{2}$ in. apart on centers) are screwed 11 in. pieces of $\frac{1}{2}$ -in. iron pipe into which are slipped 12-in. pieces of $\frac{1}{4}$ -in. brass tube which are threaded into $\frac{1}{4}$ -in. brass elbows. A $3\frac{1}{2}$ -in. brass nipple connects each of these with a Bunsen burner by means of an ordinary $\frac{1}{8}$ -in. brass ell gas cock. A packing joint is made between the $\frac{1}{2}$ -in. iron pipe and the brass tube by means of an ordinary valve stuffing box. A ring is soldered to the end of the brass tube to prevent its slipping through the packing and to hold it more rigidly upright. Two other 1-in. $\times$ 1-in. $\times$ $\frac{1}{2}$ -in. tees carry 11-in. sections of $\frac{1}{2}$ -in. pipe plugged with solder, which are connected to the condensers by ells and short nipples, and act as supports. The three upright 30-in. sections of 1-in. gas pipe which support

the entire apparatus are screwed into 1-in. $\times$ 1-in. $\times$ 1-in. tees. Two of these pipes are plugged with solder while the one at the right, which is shown in the picture, carries the 1-in. gas valve. All three are fastened to the table by 4-in. flange plates.

The ordinary retort rings used in the old still are replaced by socket clamps and rings on 7-in. shafts. In order to fit on the $\frac{1}{2}$ -in. gas pipe supports it was necessary to use the large sort of clamp used in physics laboratories. The clamps are fastened to the support to the right of the burner which is to be used. The last one is attached to the $\frac{1}{2}$ -in. waste water pipe. This arrangement admits of easy centering of the flames under the flasks in any position, a thing which was not always possible with the variations in nipple-lengths and threading when the ring and burner had the same support and had a common center of movement.

The condensers are made of $13\frac{1}{2}$ -in. pieces of 1-in. gas pipe, fitted with 1-in. $\times$ $\frac{1}{2}$ -in. $\times$ $\frac{1}{2}$ -in. tees and valve packings to hold the $\frac{1}{4}$ -in. block tin inner tubes. They are joined with $\frac{1}{2}$ -in. pipe. Where the condensers are supported, 1-in. $\times$ 1-in. $\times$ $\frac{1}{2}$ -in. tees are inserted and fastened to the supports by means of short nipples. The condensers are set at an inclination of about 60° with the horizontal. We prefer the inclined condenser to the vertical because there seems to be less tendency to sputter. The block-tin inner tube extends $2\frac{1}{2}$ in. below and $11\frac{1}{2}$ in. above the end of the packing boxes. The tin pipe is easily bent by hand into the desired shape. The ends were cut off at an angle in a miter box. The cooling water passes through all the condensers and is wasted into a sink. The use of 1-in. $\times$ $\frac{1}{2}$ -in. $\times$ $\frac{1}{2}$ -in. tees instead of 1-in. $\times$ 1-in. $\times$ $\frac{1}{2}$ -in. tees makes a neater appearance and in connection with the valve packing allows the use of water under the full pressure of the city mains.

Our still bank consists of 15 units. It has been in constant use for about 18 months and it has not been necessary to replace a packing. It has been found possible to make fifteen determinations at one time on the hottest summer days with the tap water at 18° C. without using the full pressure of the mains at any time. The water distilled over at the rate of about 10 cc. a minute and all tubes were cool.

The apparatus was constructed by the university's plumbers. New material was used throughout. The cost of material was roughly as follows:

Tin pipe.....	\$19.35
Brass tube and fittings.....	6.77
Iron pipe.....	7.50
Tees and ells.....	6.00
Valves and unions.....	2.75
Burners.....	3.00
Rings and clamps.....	19.19
Flange plates.....	0.28
Packing boxes.....	5.66
Total.....	\$70.50
Cost per unit.....	\$ 4.70

¹ Barnard and Bishop, *J. Am. Chem. Soc.*, **28** (1906), 1999; Bishop, *This Journal*, **7** (1915), 693.