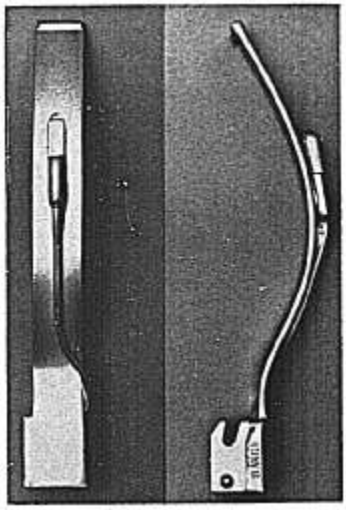
It is encouraging to me to learn that chloroform is being used in the Copper Kettle by others than ourselves. I continue to believe that chloroform is a most useful agent which has been inordinately maligned. Chloroform is without doubt the most potent inhalation agent yet available as measured either by the volume percentage of vapor required for anesthesia or by the extremely small increments in concentration which produce changes in depth. It was the recognition of the need of a means which would allow minute changes in and discrete control over chloroform vapor concentration that eleven years ago first stimulated me to build the piece of laboratory equipment which was the original prototype of the Copper Kettle.

The basic principles incorporated in the Copper Kettle vaporizers design allow an efficient performance with all liquid anesthetic agents, *i.e.*, the carrier gas-vapor mixture at the outflow of the vaporizer is a saturated vapor at the temperature of the gas-liquid interface (which is the vaporizing surface), even at carrier gas flows up to several liters per minute. Users of such a vaporizer who wish to calculate the concentration of an agent from its known saturated vapor pressure curve must not fail to remember that the vapor itself takes up space, providing a larger volume of outflow from the vaporizer than the measured volume of carrier gas inflow. For example, a measured inflow of 300 cc. of carrier gas per minute will at 24 C. pick up approximately 100 cc. of chloroform vapor thus producing an outflow from the vaporizer of 400 cc. of 25 per cent chloroform vapor, while with ether at 24 C. 300 cc. will pick up over 600 cc. of vapor giving a total outflow of approximately 900 cc. of 68 per cent ether vapor. In either case it would then be necessary to dilute the flow from the vaporizer fifty times in order to provide a reasonable maintenance concentration.

GADGETS

Blade for Lateral Intubation

Dr. Clifton Dance, Jr., of Ft. Lauderdale, Florida, advocates intubation in the lateral position (in chest and kidney cases), for the following reasons: to avoid hypotension during change of position of anesthetized patient; to decrease anesthesia time; to provide opportunity to obtain baseline preanesthetic assessment of patient's tolerance of lateral position (plus kidney lift and acute lateral flexion); to minimize need for assistance from operating room personnel in placing patient; to minimize low back strain in personnel; to facilitate checking pressure points to avoid neuropathies; to minimize displacement of intravenous needles; to determine electrocardiographic alterations coincident with changes in position; to be able to defer or avoid intubation in patients with satisfactory airway after trial of position and anesthesia.



Laryngoscope blade for intubation in the lateral position.

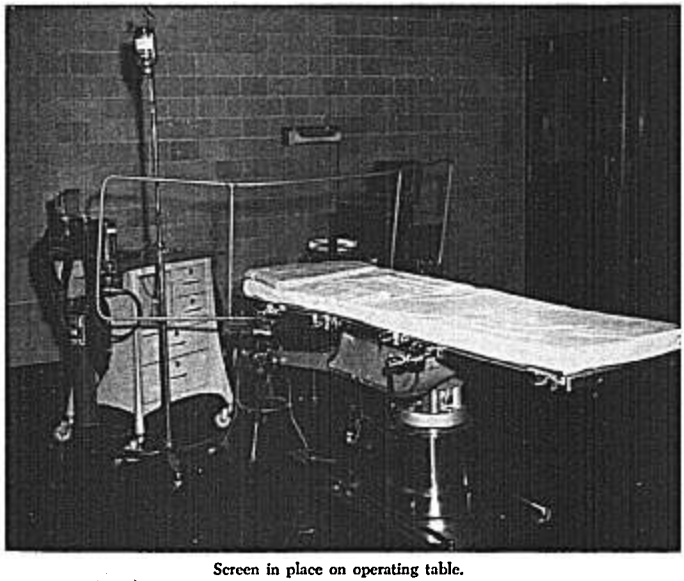
He improvised the illustrated laryngoscope blade as an aid to intubation in the lateral position. No wall is present, thereby making a lateral approach with the tube to the glottis possible from either side (in contrast to the conventional Macintosh where the wall makes an approach from the left side quite difficult). The light is centered in the midline so that it will not be encroached upon by soft tissues abutting the edge of the blade in either lateral

position. The light has been advanced over the curved surface to compensate for lack of height in the emplacement. The degree of curvature is slightly less than that found in the Macintosh no. 3. For some patients an advantage is found in flattening the blade even more. (The blade can be bent by hand but it requires greater pressure than that exerted during intubation.) The blade is 22 mm. longer than the conventional Macintosh no. 3, the additional 22 mm. being added as a straight section between the flat blade seat and the curved section of the blade, thereby increasing the length without increasing the curvature. A desire to minimize obtrusion of the bulb in the center of the field led to consideration of recessing the terminal centimeter of the wire and the bulb socket in a channel in the blade, with the bulb sunk in a fenestration. However, reports of the possible hazard of burning the base of the tongue with such an exposed bulb forced reconsideration. Other structural modifications such as dishing the blade distal to the bulb or utilizing a recurved tip as in the Fink blade are being evaluated with this problem in mind. A straight version is also available with the light in the center, no wall, and a total length of 175 mm.

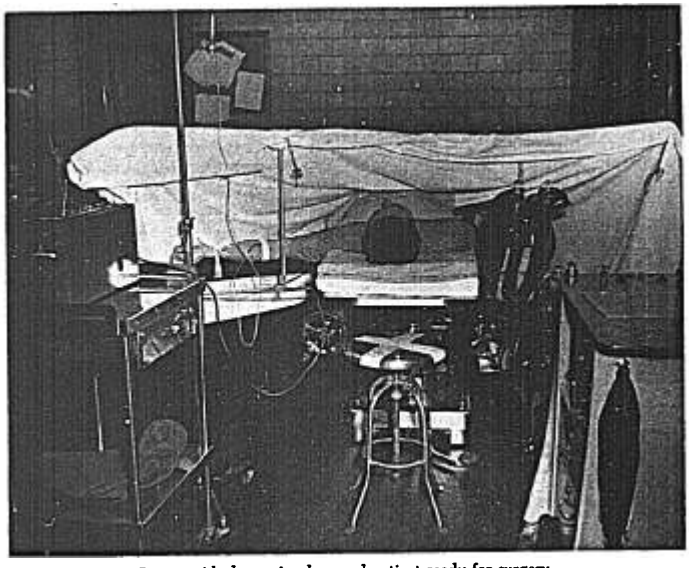
The blade illustrated is quite suitable for intubation in the conventional position and here offers the advantageous decrease in the vertical component (the wall) lessening opportunity for trauma to the teeth.

Operating Table Screen

For the past several years Drs. D. H. Morrow and V. K. Stoelting have been employing a modification of the standard Kocher ether screen at the Indiana University Medical Center Hospitals; the screen being used most extensively for major abdominal and thoracic operations. They report at this time with the hope that the screen may find wider usage in maintaining the necessary aseptic barrier between the surgeon and anesthesiologist in a crowded operating room.



Screen in place on operating table.



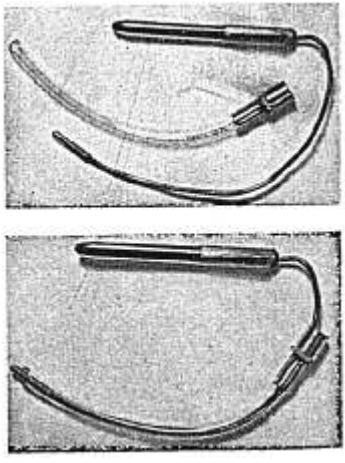
Screen with drapes in place and patient ready for surgery.

The screen, measuring 60 inches in length and 22 inches in height, is made from ½-inch aluminum rod. It fits the standard ring adapters supplied with the operating tables. The illustrations show the screen in place on the operating table, and the advantage of this screen with drapes in place and patient ready for surgery.

It has been found to be quite pleasing to the surgeon in allowing all recording equipment, intravenous stands and the gas machine to be draped completely out of the operating field. It is quite acceptable to the anesthesiologist since it gives ready access to the patient's extended arms, and good support to the upper arm with the patient in the lateral position.

Lighted Stylet

Dr. Robert A. Berman of Far Rockaway, New York, uses a maleable stylet with a light at the end. The stylet is attached to an ordinary pen flashlight. The stylet is inserted in an endotracheal tube in the usual manner and



Maleable stylet with light at end from ordinary pen flashlight for use in inserting endotracheal tube.

the light is turned on. The larynx is exposed with a laryngoscope and the tube is inserted with the aid of the lighted stylet. Dr. Berman believes that this stylet has proved extremely valuable especially when the fickle light of the laryngoscope has gone out at the most inopportune time. He has used a plastic laryngoscope with only the light from the stylet to expose the larynx. This makes it possible to expose the larynx without a lighted laryngoscope.

Adaptors for ECG Electrodes

Dr. Thomas H. Cannard of Philadelphia believes that the necessity of applying plate electrodes with messy paste and straps that become lost and the frequent change of contact beneath the drapes has been a deterrent to routine use of the electrocardiograph.

We designed and requested a company to make adaptors with a thumb screw for attachment to standard Sanborn electrodes. The low and relatively constant resistance of this electrode has been particularly useful with low input impedance transistor amplifiers as well as with standard electrocardiograph equipment. A sterile 23 gauge short needle is attached to the adaptor and placed beneath the patient's skin. This is fastened with adhesive tape and completes the electrode. Contact has been improved and the electrocardiograms more reliable. Paste and straps have been obviated. He has found no disadvantages in their use.

Adaptors with thumb screw for attachment to standard Sanborn electrodes.

New Valve for Nonrebreathing Systems

Drs. M. Jack Frumin, Arnold S. J. Lee and E. M. Papper of New York believe that the usefulness of precise vaporizers in anesthesia is enhanced by efficient nonrebreathing systems. The following apparatus was devised as part of a nonrebreathing system for administering definite concentrations of anesthetic or analgesic mixtures. The main requirements placed upon this system were (a) reliability (b) simplicity in operation (c) applicability to both adults and childen (d) usefulness in both spontaneous and controlled respiration and (e) safeguards against either inadequate or excess supply of inspiratory mixture.

The Nonrebreathing or Face Valve

This valve consists of a common chamber, an inhalation and an exhalation valve, and three ports—inhalation, patient and exhalation (as illustrated). A rubber disc between the common chamber and the inhalation port acts as a check valve, and allows the gas to flow in only one direction—from the inhalation port into the common chamber. The patient port fits into an anesthetic face mask and over an endotracheal tube fitting. A flexible hollow rubber "mushroom" covers the exhalation port. The shape of the "mushroom" makes its effective area (when considered as a pneumatic diaphragm) greater than the area of the exhalation port. A duct connects the cavity of this "mushroom" with the inhalation port. Resistance to gas flow during either inspiration or expiration is 1.5 mm. Hg at 60 l./minute flow rate.

This valve can be used under three conditions: spontaneous respiration, intermittent positive pressure breathing and spontaneous respiration when the gas supply from an anesthetic apparatus is less than the inspired volume.

Spontaneous Respiration. During inspiration, gas is drawn by the patient from the inhalation port past the inhalation valve, into the common chamber and through the patient port. Since the inhalation valve offers a slight resistance to gas flow, the pressure in the inhalation port (and, therefore, also in the "mushroom") is slightly higher than in the common chamber. The "mushroom," there-

fore, seals off the exhalation port. In fact, the resting position of the "mushroom" normally seals off that port. During exhalation, the patient expels the exhaled gas through the patient port, the common chamber, and the exhalation port to room air. The inhalation valve keeps the exhaled gas out of the inhalation port, and also prevents transmission of the exhalation pressures to the interior of the "mushroom."

Intermittent Positive Pressure Breathing. During the application of positive pressure to produce inspiration, the pressure which is applied to the inhalation port is also transmitted to the interior of the "mushroom." Whenever a pressure above atmospheric exists simultaneously in the inhalation port and in the common chamber, the force exerted by the "mushroom" to close the exhalation port is greater than the force exerted from the common chamber to open this port. The reason for this action of the "mushroom" is the fact that the effective pressure area of the "mushroom" is greater than the pressure area of the exhalation port. This mechanical advantage firmly seats the "mushroom" on the exhalation port, and allows gas to flow only into the patient. When inspiration ends, and the pressure in the inhalation port and in the "mushroom" returns to atmospheric, the patient can exhale freely to atmosphere through the exhalation port.

Spontaneous Breathing with Inadequate Gas Supply. In other nonrebreathing valves currently used in clinical anesthesia, the rigid check valve in the exhalation port prevents inhalation of room air if the source of gas is insufficient. If no gas mixture is supplied to the inhalation port during spontaneous respiration, the patient is unable to inhale anything. If the volume of the mixture supplied is less than the inspired volume, because of a sudden rise in ventilation, etc., the reservoir bag will gradually empty and the patient will be able to inhale only this inadequate gas supply. This difficulty is obviated with the present valve. If no gas is available in the inhalation port, the negative pressure generated by the patient during spontaneous breathing will be transmitted to the inhalation port and, therefore, also into the "mushroom." Atmospheric pressure will collapse the "mushroom," raise it off the exhalation port, and allow room air to be drawn in. A negative pressure of less than one mm. Hg will produce this effect. Exhalation will occur as previously described.

The action of the only movable parts—the inspiratory check valve and the rubber "mushroom"—can be observed since the device is constructed of a transparent acrylic plastic. In practice the valve has proven to be durable and efficient.

A Pressure-Equalizing Valve

The inflow of gas mixture into a nonrebreathing system can be less than, equal to, or greater than the outflow. If the inflow is less than the outflow, the reservoir bag will gradually empty and an inadequate supply of gas mixture will be available for breathing. Even though the nonrebreathing face valve permits the breathing of room air under these circumstances, the anesthetic gas will be diluted with room air. It is difficult in practice to match the patient's minute volume exactly without frequent readjustment of the inflow rate. Therefore, a nonrebreathing system is usually operated with the inflow distinctly greater than the outflow rate.

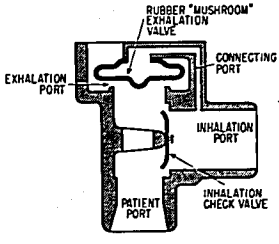
A serious defect may arise when a nonrebreathing valve is used which has automatic shut-off of the exhalation port when positive pressure is applied. Excess gas cannot escape from the system herein described because the pressure built up in the reservoir bag by the excess gases is transmitted to the "mushroom" valve covering the exhalation port. This pressure constitutes a resistance to exhalation and may, if large enough, prevent exhalation entirely. This complication is particularly apt to occur during controlled respiration in an apneic patient. The difficulty can be obviated by a number of maneuvers. The inflow rates can be readjusted repeatedly, the bag emptied periodically, the inflow stopped temporarily, or the pneumatic connection to the "mushroom" can be broken temporarily.

If breathing were always spontaneous, a simple spring or gravity loaded pressure relief valve which opens at a pressure just sufficient to keep the reservoir bag inflated (1 mm. Hg) would be entirely satisfactory in preventing overdistention. Such a relief valve would be unsatisfactory during assisted or controlled respiration when the reservoir bag is compressed

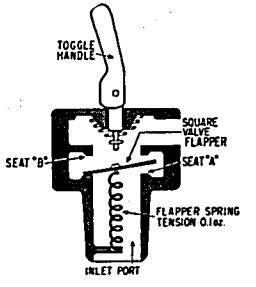
since gas would be discharged into the atmosphere instead of to the patient.

In order to allow excess gas to escape, and at the same time permit positive pressure inspiration, a "pressure equalizing" valve was devised. This valve distinguishes between the pressure build-up from excessive gas flow into the system and the pressure rise due to the compression of the reservoir bag during intermittent positive pressure breathing (as illustrated).

This "pressure-equalizing" valve contains a weighted square teflon valve flapper which moves between the circular seats "A" and "B" 0.625 inch in diameter. The flapper moves within a cylindrical housing only slightly larger in diameter than the diagonal of the square flapper. Valve seat "A" communicates with the inlet port which is connected to the breathing gas circuit, preferably near the reservoir bag. Valve seat "B" is open to atmosphere. The flapper weighs 2.9 G. and the pressure required to lift it off seat "A" is approximately 1 mm. Hg and is the minimum necessary to keep the reservoir bag reasonably inflated. This valve can be made portable and can then be used in any position by replacing the weighted teflon flapper with a very light mylar flapper which is lightly spring-loaded against seat "A."



Nonrebreathing or face valve.



Pressure-equalizing valve.

When the patient respires spontaneously and an excess flow of gas is admitted into the system, the smooth inflow of the excess gas and the smooth rise in pressure in the system lifts the flapper slightly off seat "A." This allows the excess gas to discharge to atmosphere through seat "B" and prevents overdistention of the bag. But, if the reservoir bag is rapidly compressed as during intermittent positive pressure breathing, the momentary high velocity of the escaping gas lifts the flapper against seat "B" sealing it off from atmosphere.

It is possible to seal seat "B" inadvertently if the pressure rise at any time should be rapid, especially if the excess rate of gas inflow is very high. As a safety feature, a metal rod can be inserted into the cavity of the valve so that the flapper is prevented from seating against seat "B." The metal rod is controlled by a toggle handle. When the handle is extended upward, the valve will allow positive pressure respiration. When the handle is depressed, pressure cannot be built up under any circumstance.

CASE REPORT

Airway Obstruction During Pneumonectomy

Drs. Pelagio Layug, Robert Wilder, and Peter Safar, of Baltimore report an unusual type of airway obstruction which occurred during a left pneumonectomy for a fungating carcinoma of the left main bronchus in a 38 year old colored man.

Roentgenographic examination prior to surgery revealed atelectasis of the left lung. Bronchoscopies demonstrated a pale friable fungating mass in the left main stem bronchus which reached the carina but appeared to be attached several millimeters below the carina. This tumor mass occluded the left main bronchus completely. Biopsy revealed an anaplastic carcinoma.