A HISTORICAL NOTE

The Way It Was

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The cassette played softly in the background. Talking was quiet and calm, monitors beeped their measured beat. Then, "O.K., let's go on," and another routine pump run had started.

Now let's go back almost 20 years ago. There was no soft music, no quiet and controlled conversation. Monitors—they were huge, noisy beasts that were unreliable and cranky to operate. But the best was yet to come. In a voice tense and bordering on hysteria, the word came—"Is everyone ready? Careful now, let's get going!"

What little quiet there was in the room was shattered by two sigmamotor pumps operating at once. Now a sort of pandemonium took over. Speed was the order of the day.

Coming off the pump was the most traumatic event of the day for everyone in the room. The big question was, "Will he or won't he come off?" It was not unusual when the patient did not, but this was the price that was paid for the quiet, routine case of today.

Today we question, "How could this or that have happened?" But you must remember that this was in the late fifties. Cardiopulmonary bypass was yet to become the exact science we know today.

At our institution, Hines Veterans Administration Hospital, we had been doing closed mitral commissurotomies prior to 1955. Near the end of the 1950's it was decided to do open heart surgery. Of course, the primary piece of equipment was the "Heart-Lung Machine." Just about every team was trying their hand at designing their own equipment at this time.

At the Veterans Administration, the consulting cardiac surgeons had designed a "Heart-Lung Machine" and were using it at another hospital. This machine was known as "The Lopez-Belio, Julian Pump." The surgeons decided to use the pump they designed at Hines.

A machine shop on the south side of Chicago was contracted to hand make the basic components. In the original contracts, provisions were made for an elaborate assortment of metal connectors to be made by the same machine shop. Tubing was ordered in bulk, in an assortment of sizes from a supplier.

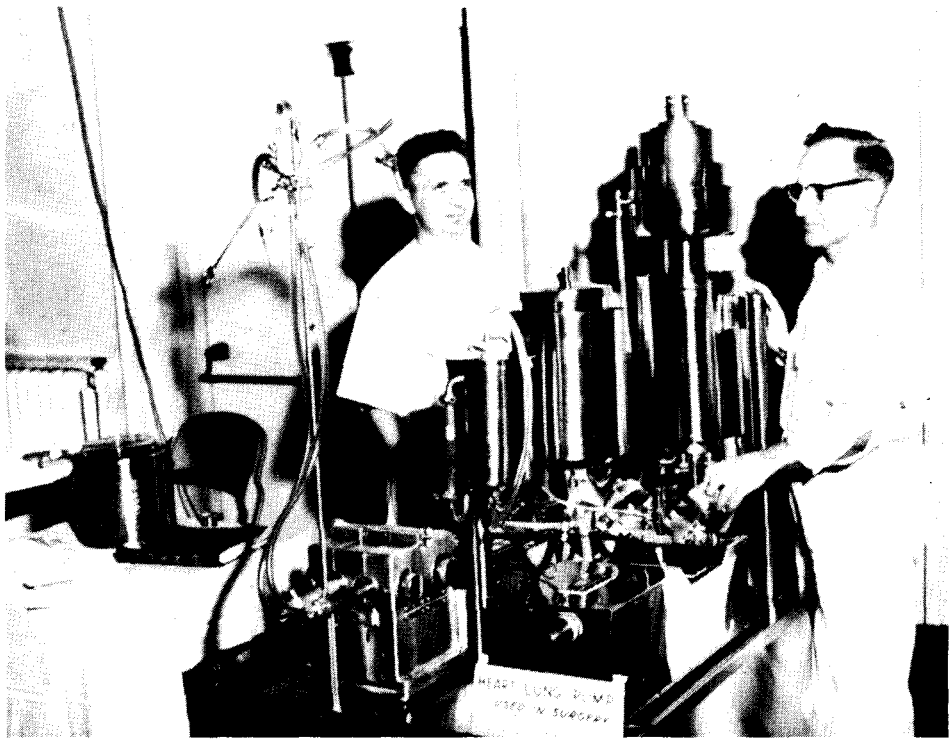

Figure 1. Lopez-Belio-Orman Julian Heart Lung Machine, Vintage 1958. On the left is Clarence Colby, C.C.P. with his associate, Nicholas Heisten. Picture was taken at a Career Day demonstration at V.A. Hospital, Hines, Illinois.

The great day when the "Pump" arrived from the shop finally came. What a cleaning job came with it! Of course this was before the Ultra Sonic Cleaner was available. Instead we used a combination of pipe cleaners, applicators, sponges, brushes and several boxes of *Tide*. We also used a lot of time and muscle. We did not have the slightest idea of how to assemble this "monster."

Now the time had come for us to learn to be masters of this new addition to our team. A few of us had been chosen to go to the other hospital to learn how the pump was assembled and operated. This truly was a day to remember—new sights, new sounds, new impressions all at once. We tried to retain everything and anything we saw and heard.

Back in our own hospital, it was time for a trial run. Our minds went completely blank. It was all so new that everything we had seen and heard was forgotten. Fortunately, the people at the other hospital had given us a typewritten set of instructions on how to assemble the pump. In the picture (Fig. 1) accompanying this text can be seen a binder labeled A^{0}ORN. We came to know this as our bible. It contained all the information about the pump.

Following the assembly instructions to the letter, we experienced our first success. We put the pump together!

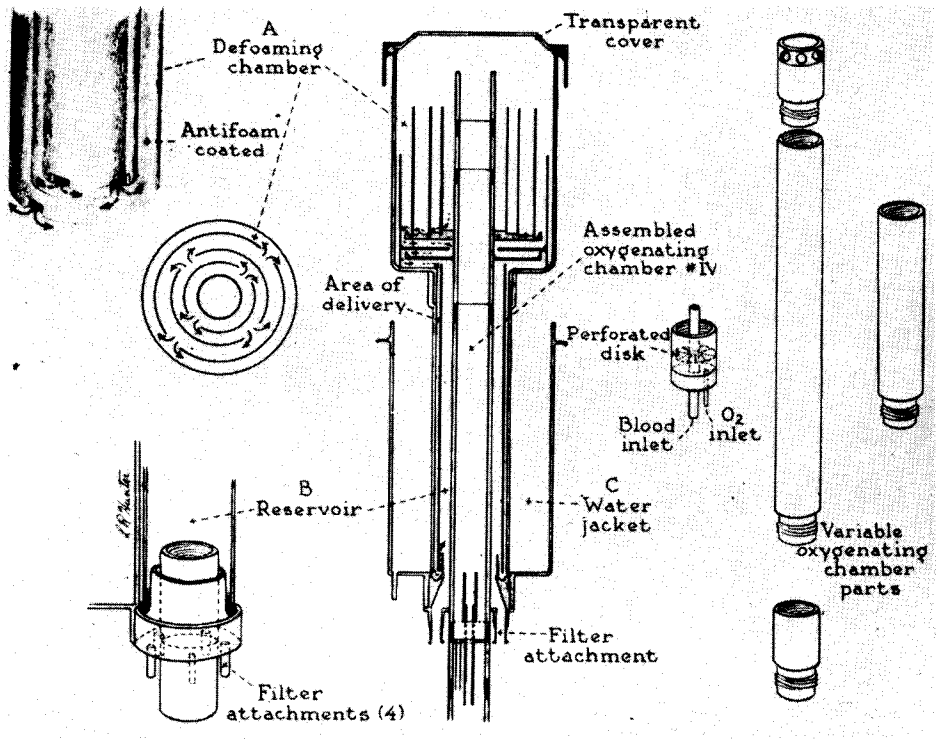

Figure 2. Cross-section of the oxygenator with the mixing and defoaming chambers and the base with its filter attachments. The arrangement of the openings between various cylinders of the defoaming chamber is shown. These openings provide for defoaming by skimming action and minimum contact with antifoam-coated surfaces.

Preparation moved ahead rapidly at this point. PVC tubing was cut to the exact millimeter called for in the instructions. Folders of heavy muslin with pockets for each piece of tubing were sewed by the hospital seamstress. In this we placed each piece of tubing, in its own pocket, after we had washed it in *Tide* and rinsed it in distilled water. The folder was then well padded with ABD pads and wrapped for steam sterilizing. After this, it required 24 hours of slow cooling to return the tubing to a clear condition. We found the two biggest problems of steam sterilizing were cloudy tubing and tubing that would kink and could not be straightened.

The latex tubing that went through the sigmamotor pump was cut to the proper length, then placed in a solution of water and sodium bicarbonate and boiled for one half hour. This was done to remove any acids remaining on the latex tubing after vulcanizing.

Each part of the pump, and there were many, was wrapped and sterilized. A tray containing spools of wire, wire twisters, wire cutters, screw drivers and other tools were also sterilized with the pump parts.

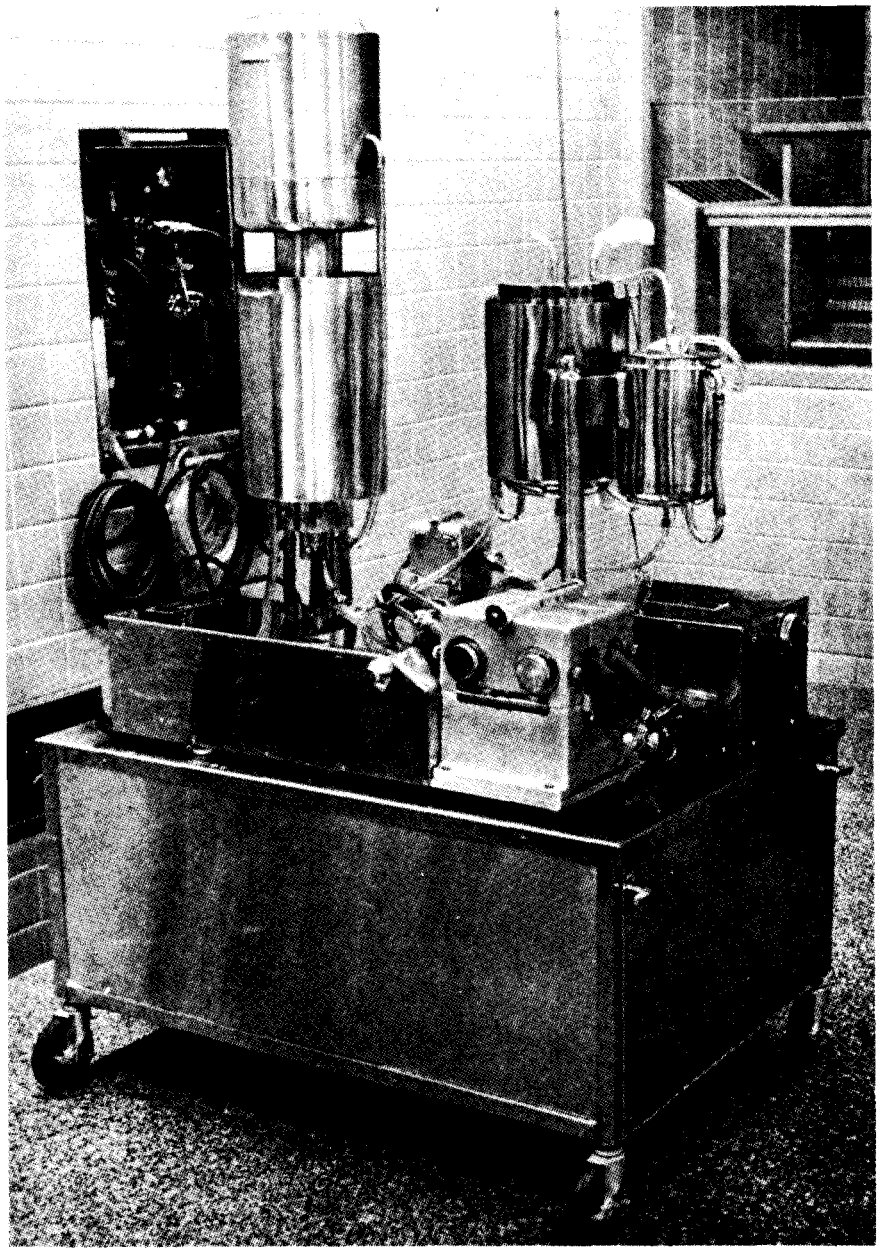

Figure 3. Assembled oxygenating equipment with axillary chambers and their connections.

Our first operation was to be an open mitral commissurotomy. On the day of surgery, the team assembled in the operating room at 6 A.M. After a routine surgical scrub, two of the team gowned, gloved and prepared to assemble the pump. A third person read from

the typewritten instructions, one line at a time, while the pump was assembled. Slowly, it began to take shape. Each connection was wired. At last it was all together.

The arterial and venous lines were connected through a bridge and wrapped sterile. Now we were ready to prime. Eight units of pre-heparinized blood were run into the priming reservoir. This was transferred to the oxygenator by one of the sigmamotor pumps. De-airing of the system was now begun. The blood was circulated through the oxygenator, across the defoaming drums, through the arterial and venous lines and back to the oxygenator. There were four Abbott inline filters on the arterial side. Both arterial and venous blood was pumped through sigmamotor pumps. Large amounts of Dow-Corning anti-foam spray had been applied to the defoaming drums. The oxygenator was a bubble type. The length of the oxygenating column could be changed to meet the requirements of the individual patient, but once assembled could not be changed.

There was no heat exchanger. A jacket circled the oxygenator column. One person in the operating room was assigned to go to the scrub sink to fill a pitcher with hot water. This was poured in the jacket around the oxygenator column. He then would drain a pitcher of water from the bottom of the jacket, return to the sink and continue to repeat this process. Needless to say, this was not a very efficient heat exchanger.

With this equipment, each case was its own adventure.

When the patient was on bypass, the noise in the room was deafening, and shouting was a necessity.

All the cannulas used were metal. The suction was applied by wall suction. No suction blood was ever reinfused from the oxygenator to the patient.

The longest safe time on bypass was in the range of 40 minutes. The rule was, the shorter the time the better. Coming off the pump was just a simple command from the surgeon to shut the pump off. There was no such thing as coming off the pump slowly.

Our first patient lived. We knew this had to be a miracle, but we had done our best with the best equipment available.

Cleaning up and getting set for another case usually took us a week or more. More pipe cleaners, more applicators, more sponges and brushes and, of course, more *Tide*. But we went ahead.

Later came Pemco, Disc and Olsen. Each new pump and oxygenator was a vast step forward. With efficient disposable oxygenators, reliable pumps and a large background of knowledge, we can finally say "Cardiac surgery and cardiopulmonary bypass are routine." But we had traveled a long, difficult road. We learned much in our travel.

Figures 2 and 3 from Lopez-Belio, Mariano and Julian, Ormand C: High output bubble oxygenator with variable oxygenating changer for cardiac bypass. *Surg*, 47:772–783, 1960.