



Guest Editor

Mrs. John Gibbon

1978 Featured Speaker
AmSECT Awards Dinner

Personal Recollections of the Earliest Years of the Development of the Heart-Lung Machine

Ladies and gentlemen, doctors, nurses, technicians, Fellow Perfusionist, all! It is a great honor, as well as a pleasure to be your speaker tonight, because I have a story to tell that I think will be of particular interest to you. It is really the story of the Heart-Lung Machine, and someday I hope it will be a book, but tonight I can only tell you the beginning—how it all started. I thought that you might be particularly interested if I told you a little about the man who had the dream of such a thing—it might have been called “The Impossible Dream.” Because if my husband, Dr. John Gibbon had not had that dream, way back in 1930, all of you here tonight might not have the jobs that you do have, and none of us, me in particular, would not be meeting here, in San Diego, or anywhere else, all together, as delightfully as we are.

My talk tonight will be very informal, and I shall tell my story for the most part in pictures. The history itself is really a long one, covering as it does, the years from 1930 when an idea took shape in a young man’s mind, until 1953, when Dr. Gibbon performed the first successful open heart surgery using this machine, that day in May on which he closed a large atrial-septal defect in the heart of a young girl.

John Gibbon, or Jack as he was almost always called, and as I shall call him tonight, was born and grew up in the Philadelphia area, the second child and first son, in an unusually happy family atmosphere. He had one older sister and two younger brothers, whom he used to tell me he teased unmercifully, much to the distress of the older sister. This I never did believe. He had an adoring mother and a firm but kind father, a surgeon and a professor of surgery at the Jefferson Medical College, as Jack was to be many years later. He was a bright, good student who finished school at 15 and was sent to Princeton. He graduated at the age of 19 and wanted to be a poet but instead entered Jefferson Medical College and graduated in 1972, followed by a 2 year internship at the Pennsylvania Hospital.

**Permission to publish the following photographs is granted by Mrs. John Gibbon.*

This chapter opens on an October day in 1930. At that time I was 24 years old, and was a technician and research assistant to Dr. Edward D. Churchill at the Harvard Medical School and Jack Gibbon, who was then 26 years old, was a Fellow in Surgical Research at Harvard. Jack, the son, grandson and great grandson of surgeons, grew up in Philadelphia, and here you see him at an early age, chasing a butterfly or perhaps more characteristically, an idea.



Next, he is a little older with that look of concentration which was characteristic.



This is how he looked in 1929 when I first met him.

Then a little about me. I grew up in the Boston area, also fortunate to be one of a happy family group. This photo shows me as a rather glum young miss, thoughtfully chewing on a stem of grass in my mother's garden.



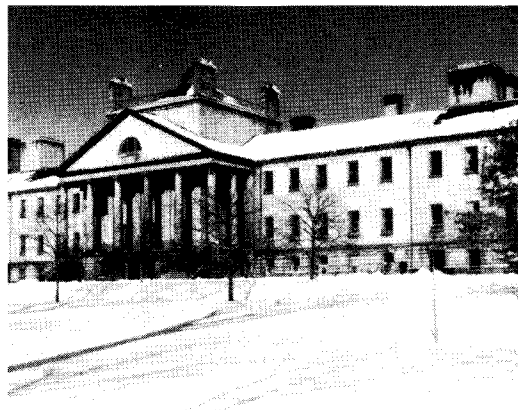
This is a portrait of me and my four sisters and my parents painted by my father, a well known Boston artist and portrait painter.



My interest in medicine began when, after two years at Bryn Mawr College, I spent a winter in Paris, sharing an apartment with a young cousin who was married to a doctor. That winter changed the course of my life, because night after night I listened to talk about medicine and medical research. I was fascinated, as a new world opened up to me. I made the decision then and there to get myself into this world of medicine, by hook or by crook—and I may say here that it was necessary to use both means, because I had no college degree, nor had I taken any of the basic sciences, like chemistry, biology or physiology, either at school or college. But with the courage and brashness of youth, I applied for a job at the Harvard Medical School's Placement Bureau, and was extremely fortunate to secure immediate employment with Dr. Churchill.

So I had been Dr. Churchill's technician for some time when Jack Gibbon came to Boston in January 1930. He had finished his two year rotating internship at the Pennsylvania Hospital in Philadelphia, had travelled briefly in Europe with a friend, and then returned to the United States early in 1930, to start a year in Boston, at the Harvard Medical School to learn from Dr. Churchill all he could about surgical research, its problems, techniques and its fascination.

This is the Bullfinch Building, a part of the Massachusetts General Hospital, and our laboratory was on the second floor in the right wing.





Dr. Churchill as shown here later became famous as the John Homans Professor of Surgery at the Harvard Medical School. Both Jack and I admired him almost to the point of reverence—if our first child had been a boy he surely would have been named Edward Churchill Gibbon.

During the winter, summer and autumn of that year we worked in the laboratory together on various surgical problems and published a few papers. The Heart–Lung Machine story started on an autumn day that seemed just like any other day, but actually October 3, 1930 was a day that changed surgical history and opened up the hitherto closed gates to open heart surgery.

On that Friday afternoon a female patient at the Massachusetts General Hospital suffered a postoperative massive pulmonary embolism. Dr. Churchill sometime before this had altered the hospital staff to recognize the symptoms of massive pulmonary embolism because he had a special interest in this rare and dangerous condition. Hence he was called at once to see the patient and he and Jack quickly left the laboratory. Over in the hospital, Dr. Churchill gathered his team together and had the patient taken to the operating room for extended observation. Jack's assignment was to record the patient's blood pressure, pulse rate and respirations every 15 minutes, while during a long night's vigil Churchill and his operating team waited, scrubbed up, masked, hands gloved, in complete readiness to operate. Churchill was unwilling to start such a hazardous operation before he was certain that the patient would otherwise die. In those days the operation of pulmonary embolectomy or a Trandelenberg operation as it was called—carried such a high mortality that operating before the patient was almost moribund was taking an unjustified risk. Only nine of 142 patients operated upon in Europe had survived the embolectomy and no successful operation had yet been reported in the United States.

The patient, the surgeon, the operating team and Jack Gibbon were in the operating room that day from 3:00 in the afternoon until 8 the following morning; at times the patient's condition seemed to improve, and the surgeon must have remembered the few recorded cases of spontaneous recovery. But at 8:00 on Saturday morning Jack had to tell Dr. Churchill that he could no longer record the blood pressure. Churchill immediately operated and removed the embolus, all within 6½ minutes, but unfortunately the patient did not survive the operation.

Three months later in January 1931 Jack Gibbon and I became engaged and we went at once to tell Dr. Churchill that we had a good idea for a new experiment.



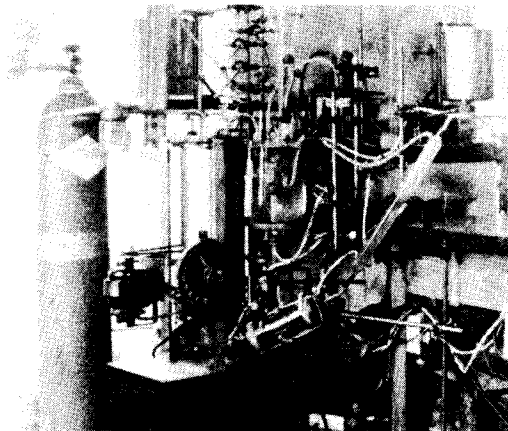
We were duly married in March 1931 and moved after that to Philadelphia because Jack's year of research in Boston was finished.

Back in Philadelphia during the next three years Jack talked to a number of people about this idea of his of artificially oxygenating blood and devising an artificial pulmonary circuit but no one was very much interested or at all encouraging. The general impression was that it would in all probability be a monstrous waste of the time and energy of a bright young investigator to embark on such an almost impossible task. We were busy enough those three years in Philadelphia but not very happy or satisfied. Jack operated with his father and Dr. John B. Flick at the Bryn Mawr and Pennsylvania Hospitals. We managed to do some original research on changes in skin temperature in our own bathroom.

Two children were born to us, first a girl and then a boy. Here are three John Gibbon's—but during all this time the thought of a Heart–Lung Machine did not fade in Jack's mind or imagination. So in the fall of 1934 he again applied to Dr. Churchill for an opportunity to test out the feasibility of this idea. Churchill was anything but enthusiastic but he was good enough to give Jack another research fellowship at Harvard, a laboratory in which to work and a technician's salary once again to me, to allow me to work with Jack on this project.

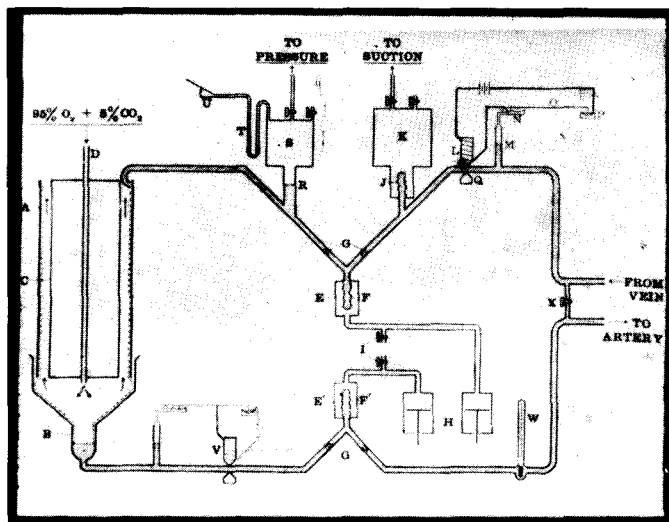


Thus the first chapter in the story of the development of the Heart–Lung Machine was begun. Our goal that year was to see if it was possible to devise and develop an apparatus capable of carrying on the functions of an animal's heart and lungs while no blood was passing through its own cardio–respiratory circuit. We used cats in these early experiments.



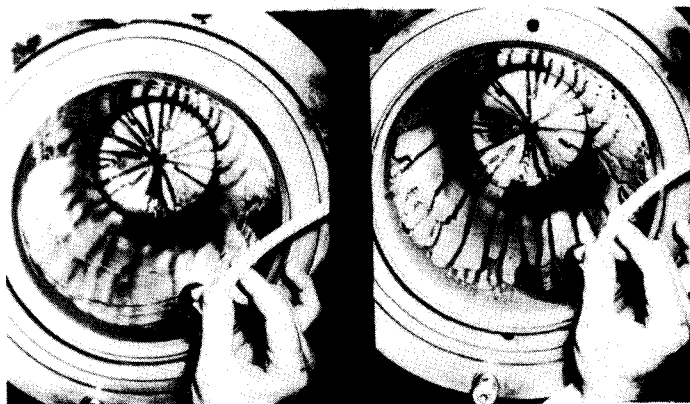
This is the way our apparatus looked and to you it must seem like a Rube Goldberg mass of jumbled junk compared with exhibits today. But to us every piece of glass and rubber was an old and valued friend.

This is a simplified diagram of the apparatus which may help you understand it better than the former photo did.



The two pumps which move the blood through our circuit are the venous Pump E which took the blood out of the vena cava and the arterial Pump E which returned the oxygenated blood to the cat's artery. We made these pumps from rubber finger cots (F and F) which were alternately compressed and expanded by air. The finger cots were placed in the circuit between two valves (G), which directed the flow of the blood. Our venous pump E spread the blood onto the inner surface at the top of our oxygenator A.

This lung of ours was a hollow revolving cylinder which caused the blood to be distributed in a thin film which slowly moved down the sides of the cylinder by gravity. Most of the space inside was filled by another hollow, closed cylinder (C), through the center of which passed a metal tube (D). A mixture of 95% oxygen and 5% carbon dioxide flowed



through this tube to the bottom of the oxygenator. From here the gas passed up between the two cylinders over the film of blood and escaped at the top. The oxygenated blood was collected at the bottom of the whirling cylinder in a stationary cup.

Then the blood was pumped by our arterial pump E back into the animal's artery. With this apparatus we were able to accommodate blood flows of 500 cc/min and introduce almost adequate saturation with oxygen. Time does not permit me to describe the other refinements shown in this diagram.

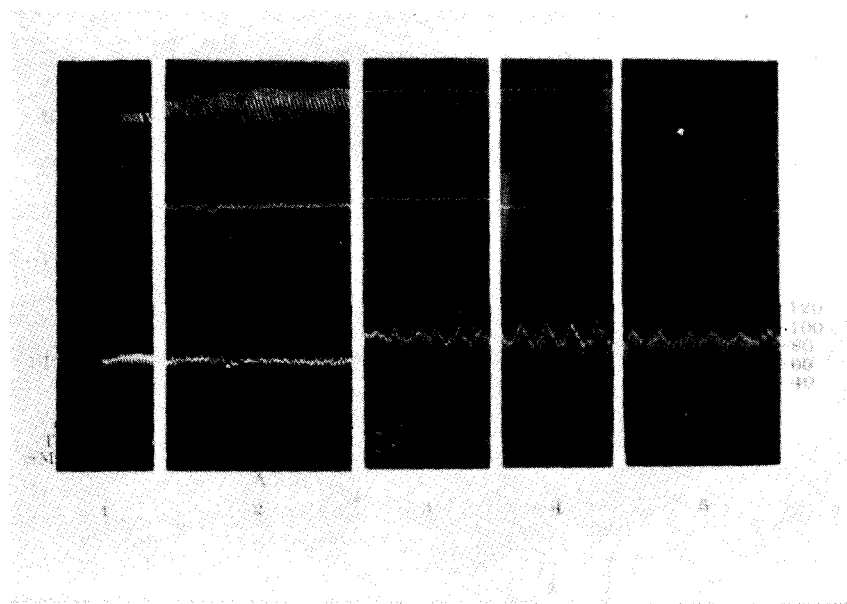
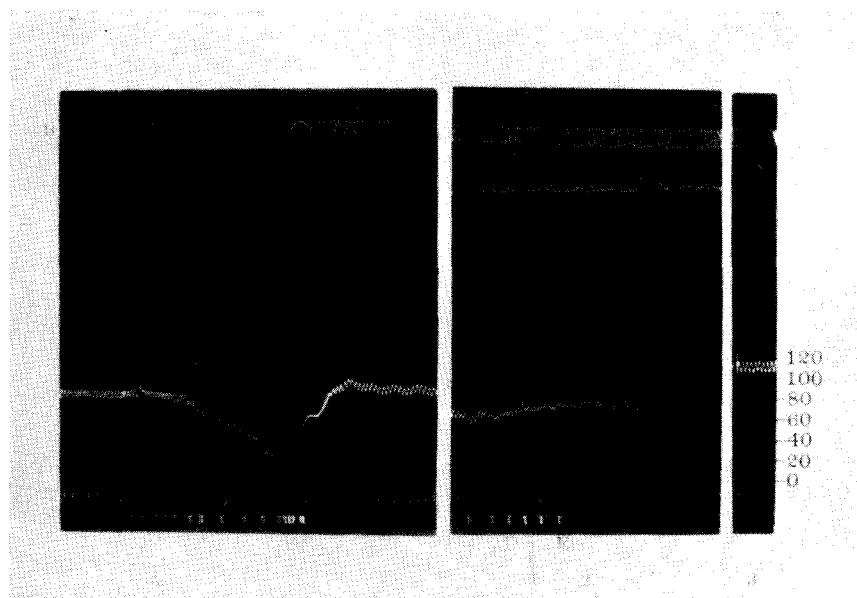
To do these experiments we had to be at the laboratory bright and early as they often continued all that day and sometimes well into the evening. We could only manage about three such experiments a week. (Dr. Denton Cooley told me last winter that he is now about to do about eight open-heart operations everyday!) First we had to smoke a kymograph record and get it in place on the operating table. Then we had to bring a cat down from its upstairs quarters and anesthetize it with sodium barbital, perform a tracheotomy and connect the animal up to artificial respiration while an operation called "Drinker Heart Preparation" was done, in order to expose the pulmonary artery in a (later) naturally breathing animal. Next, the vessels to be used for the perfusion were exposed and at the same time a 5% solution of gum acacia and saline was circulated slowly around the artificial circuit. We surrounded most of the apparatus with a hot water bath so that the solution might be near body temperature when the cat was connected to it.

Then a special, finely graduated clamp was just in place—open, around the pulmonary artery. A cannula for recording blood pressure and a device for recording respirations on the kymograph record were next arranged, the blood vessels for the perfusion were cannulated and lastly, heparin was injected into the animal's vein.

These preparations usually took four or five hours and it was mid-afternoon before we were ready to start the really critical part of the experiment. So by gradually closing the clamp around the pulmonary artery [simulating an embolus (blood clot)], while at the same time gradually withdrawing blood from the jugular vein, pumping this blood through our "lung," and pumping it back into the cat's arteries, the procedure began.

We would keep the clamp partially occluding the pulmonary artery for as long as we thought the cat could stand it, or nothing went wrong with the apparatus but the things that were apt to go were infinite: the blood in the cup at the bottom of our lung would start to foam; movements of the cat due to too light anesthesia would sometimes cause displacement or breaking of part of the apparatus; the blood pressure would suddenly drop to zero because the wall of the vena cava was sucked into the cannula, stopping all flow of blood; or the red arterial blood would look like blue venous blood as it entered the cat due to poor filming on the inside of the oxygenator. For these and other reasons we would end the occlusion of the pulmonary artery, remove the clamp around it and then gradually put the cat back on its own circulation and wait to see if it could maintain its blood pressure at a near normal level and its respirations at a near normal rate. If it succeeded to do this, the animal was nursed tenderly over a period of an hour or so. Then the experiment was terminated, the cat was sacrificed and an autopsy performed. The kymograph record was shellacked so that no cleaner's hand or broom should smudge our record. The instruments and general mess cleaned up and we could go home—a long day.

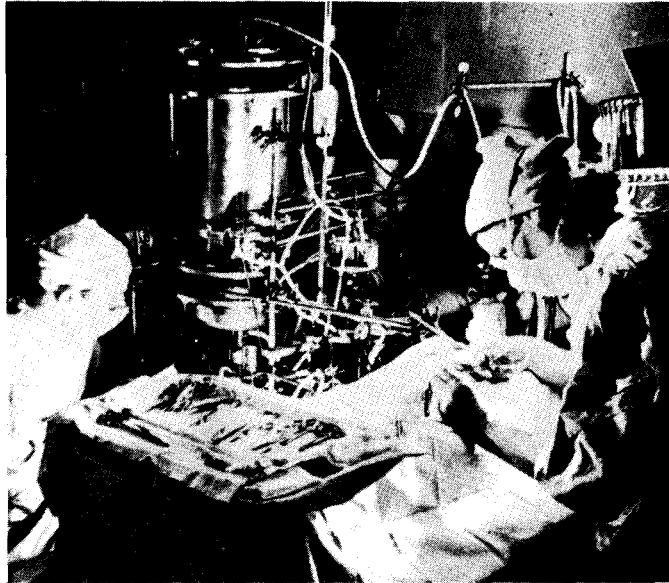
Here are two kymograph records of such an experiment. In this first tracing on the left side you see the cat's blood pressure dropping to zero as the clamp was gradually closed around the pulmonary artery. The clamp was released and the pressure returned to its original level. On the right side the blood pressure was maintained at a normal level by the Heart-Machine, while the clamp was gradually closed until the pulmonary artery was completely occluded just as it had been previously.



This second kymographic tracing illustrates the maintenance of the blood pressure and respiration for two hours and 58 minutes—our longest period of complete occlusion of the pulmonary artery.

So, in that year 1934–1935 we did successfully demonstrate that it was possible to keep an animal alive and in a relatively normal physiological state with our Heart–Lung Machine apparatus while no blood at all was passing through the animal’s own heart and lungs.

This photo is from the following year in Philadelphia showing the sterile experimental surgery suite.



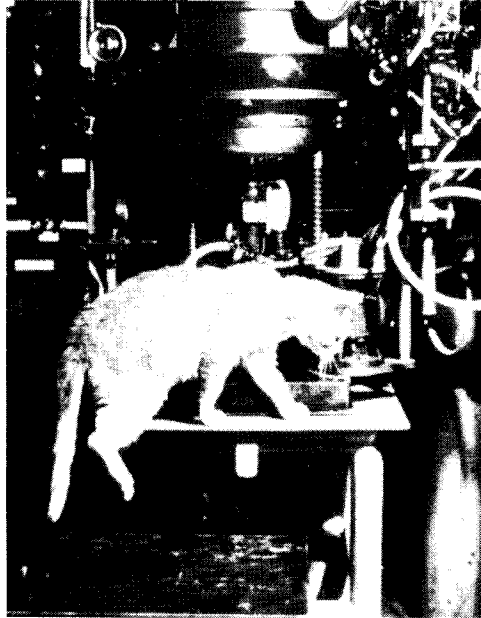
Dr. Jack Gibbon “on rounds.”



This is a cat who survived our occlusion of her pulmonary artery while on our machine and a little while later presented us with 9 small kittens!

Many years later, when my husband received an award in 1963, he described our early experiments as follows:

“The artery was compressed with the clamp until the blood pressure began to fall. The artificial circulation was then started and the pressure would return to normal and remain so. I will never forget the day when we were able to screw the clamp down all the way, completely occluding the pulmonary artery, with the extracorporeal blood circuit in operation and with no change in the animal’s blood pressure. My wife and I threw our arms around each other and danced around the laboratory laughing and shouting ‘Hurray!’ Although it gives great satisfaction to me and others to know that open heart operations are being performed daily now, all over the world, nothing in my life has duplicated the ecstasy and joy of that dance with Manly around the laboratory of the old Bullfinch Building in the Massachusetts General Hospital 28 years ago!”



Dr. John H. Gibbon

And so ends the first chapter of our story.

Presented March 2, 1978 at the AmSECT Awards Banquet in San Diego.