

ARTIFICIAL ORGANS

Proceedings of the International Symposium
on Artificial Organs, Biomedical Engineering,
and Transplantation in Honor of the 75th Birthday of
Willem J. Kolff
Salt Place Convention Center
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University of Utah


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1987

PREFACE

The University of Utah has had the enormous good fortune of having Dr. Willem J. Kolff a member of its faculty for the past twenty years. The arrival of Dr. Kolff in 1967, along with a number of his co-workers from Cleveland, set in motion the development of a biomedical engineering program second to none in the world. With the establishment of the Institute for Biomedical Engineering in the Division of Artificial Organ under Kolff's dynamic and creative leadership, the University of Utah was catapulted into national and international prominence in areas of artificial organs, biomedical engineering, and the clinical applications of the artificial kidney and the artificial heart. In addition, Dr. Kolff has stimulated a significant number of faculty, students, and staff at the University. They have gone on to develop their own research programs, in Utah and elsewhere, generally with national and international acclaim and recognition.

Many have asked the question, why Utah? A number of us have examined that question, and we think the answer is simple. Utah wanted a W.J. Kolff. Utah was willing to set up an institute which reported directly to a vice president, thereby eliminating the lower levels of bureaucracy involved in many other organizations. One high administrator of the University was reported to have said, "Every institution needs a W.J. Kolff, but not more than one!" Utah has Kolff — and Utah has others. It can assimilate and handle such exceptionally creative, talented, and prolific individuals because there is a minimum bureaucracy philosophy. The philosophy of the administration is: Help if you can; if you can't, stay out of the way. Kolff and his co-workers have prospered here, in part, because of that philosophy, but primarily because of their enormously creative, innovative, and hard working talents.

A number of years ago, friends and co-workers of W.J. Kolff at the University of Utah elected to plan an international symposium on biomedical engineering, artificial organs, and transplantation to celebrate his 75th birthday and his 50 plus years of activities and service to society. With the cooperation and encouragement of the University of Utah, the University Research Foundation, the County, and the State, the International Symposium on Artificial Organs, Biomedical Engineering, and Transplantation was held January 21–24, 1986 at the Salt Palace Convention Center in Salt Lake City. Some 700 delegates representing countries from around the world participated. A significant proportion of the co-workers, colleagues, and friends of

W.J. and Janke Kolff arrived in Salt Lake City to participate in this unique event. Many of those are represented on the program and in this volume.

The Symposium was made possible by generous contributions from an array of companies and institutions which are listed following this preface. The details were conducted by Ralph Whitener and Associates, Washington D.C. General cost and sponsorship of the meeting was underwritten by the University of Utah Research foundation, together with generous corporate and other institutional contributions.

In addition to a varied, modern, and stimulating technical program organized by the program committee (D. Olsen, R. Stephen, R. Normann, S. W. Kim), there was a rich and varied social program. There were a number of receptions for family, close associates, and co-workers of Pim and Janke Kolff, including a special concert by an institution that both Dr. and Mrs. Kolff have supported and greatly appreciated over the years — the Utah Symphony.

A special treat was the selling and auctioning of creations of natural wood. Pim and Janke Kolff over the past several years have been taking pieces of natural wood and embellishing them to produce artistic creations of remarkable diversity and interest. There creations were sold during the meeting, and the particularly outstanding ones were auctioned during a banquet at the Symposium. Proceeds from these sales went to benefit the Utah Museum of Natural History, and institution Mrs. Kolff has worked with extensively over the years and with which they both have been associated.

During his remarks at the banquet where the creations were auctioned, C. William Hall, one of the early pioneers in artificial organs and biomaterials research, said, "As exemplified by his finding occult beauty and form in pieces of driftwood, so has Kolff discovered notable qualities in persons that were often overlooked by others." It is, of course, well known to all who have worked closely with Pim Kolff that he has enormous faith and confidence in his co-workers, and many individuals have developed and flowered under his guidance and motivation.

We were particularly pleased to offer several large prizes as part of the meeting's activities. The prize for the best bioengineering-related Ph.D thesis from 1982-85 was awarded, as well as the prize for the best technical paper presented at the meeting. These prizes of \$10,000 each were made possible by gifts from the Symbion Corporation, the Baxter-Travenol Laboratories, and the Humana Corporation and brought international recognition and attention to the International Biomedical Engineering Symposium.

A few weeks after the Symposium, in February, 1986, it was announced that W.J. Kolff would receive the Japan prize — Japan's answer to the Nobel prize. The prize, consisting of an award for \$250,000, is awarded to two people each year; 1986 being only the second year of the existence of this prize. We are all proud that W.J. Kolff as one of the two recipients. An announcement appears in *Nature* 319 (1986) 711.

We thank all of those friends, co-workers, and colleagues, as well as patients, family, and supporters who participated in the International Symposium and who helped make this birthday party a memorable event. We also thank the many friends

and co-workers who were unable to attend, but sent their greetings and congratulations. We know they as well as all of the participants at the meeting, the contributors to this volume, and all friends, patients, and co-workers of W.J. Kolff everywhere, join me and the program committee in thanking Pim Kolff for his creativity, his inspiration, his motivation, and his accomplishments during the past 50 plus years. We look forward to a 100-year birthday celebration in the year 2011!

HAPPY BIRTHDAY PIM!!

J. Andrade
Salt Lake City
August, 1986

THE FUTURE OF ARTIFICIAL ORGANS AND OF US ALL

Willem J. Kolff

Institute for Biomedical Engineering
University of Utah
Salt Lake City, Utah 84112

I want to thank my long time friend, Dr. Joe Andrade for having taken the initiative to organize this conference. Dr. James Brophy took on the financial consequences of this meeting. I want to thank him and all of those who made this symposium possible. My wife, Janke has supported me for 55 years. Her extraordinary vitality has kept me healthy all these years. The patients who came from many parts of the world to attend the Symposium, will be a continuous source of encouragement.

I'm actually very much in agreement with what my friend Dr. Carl Kjellstrand said. This instrument I have here is used to comb horses. It has a lot of very sharp pins. I have covered the side that will be against my chest, but the pins on the other side will stick out so that if anybody wants to do resuscitation and cardiac massage on me by pressing his hands on my chest, it will hurt his hands and he will stop. I will give it to you, Dr. Kjellstrand.

Oxygenators. Years ago Dr. Hans Kylstra worked out a method to use ultrathin Teflon in oxygenators (1). (Crescenti and Hofstra had previously indicated the technique.) You glue ultrathin Teflon membranes on stretched elastic double-sided adhesive tape (Figure 1).

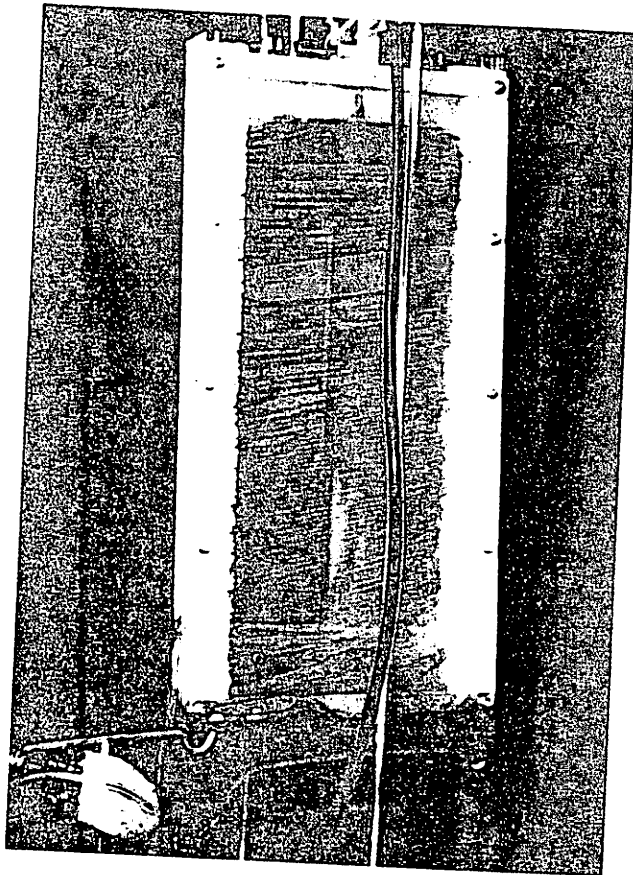


Figure No. 1

When you release the stretch, thousands of pleats result in the membranes. When you mount these membranes in an oxygenator, the blood cascades down through these pleats. They all begin to vibrate as if they were alive. It is an expensive oxygenator to make, and if a tear develops in the ultrathin membrane, any blood lost through that tear could be collected in the same receptacle so it wouldn't be a really matter. Dr. Tet Akutsu and I applied this oxygenator to a patient dying from cardiopulmonary insufficiency (2).

There is a place for membrane oxygenators to help patients in pulmonary failure. We could use this or other membrane oxygenators as an artificial placenta for premature babies, whose lungs are not capable of providing enough oxygen. Dr. Robert Bartlett discussed this at this conference. Dr. William Dorson from Phoenix, Arizona has pointed out that most likely, only a relatively short time of oxygenation would suffice to pull the baby through. Then it would not be necessary to expose the baby's lungs to pure oxygen with all the dangers of that (3). Oxygenators can also be used to preserve a donor organ until a recipient for transplantation is found.

If properly organized, we should have batteries of oxygenators (4) connected with donor hearts which might not only be preserved, but might also recover from whatever damage they incurred in their previous owners (Figure 2).

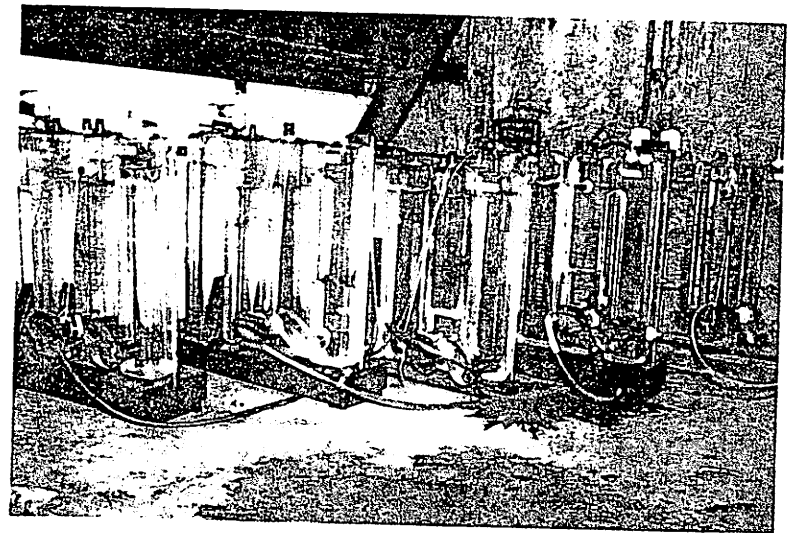


Figure No. 2

If and when about 20 of the 8,300 Russian nuclear warheads hit our cities, we certainly will have five million deaths. If one percent of them have scorched lungs before they die, we will need 50,000 membrane oxygenators, but I don't think anybody will pay any attention to this problem at that time.

Star Wars (SDI) is an impossible dream.

Twice before with a Nike Zeus and the Nike X, the administration of the United States believed they could build a protective shield against incoming bombs. This concept has been killed twice by Congress. Now we have Star Wars and again the protective shields. This one should also be killed by Congress. It is unworkable, dangerous and expensive. Here you see the challenge - the Russians fire off a bomb and we have to hit it within the first two to five minutes because thereafter, it splits into multiple nuclear warheads and even more dummies. By the time that they are in midspace you have ten warheads and about a hundred dummies. You have to intercept all or a few will get through. The dummies burn up as soon as they reenter the atmosphere, but a few bombs will get through. The principle is that we will have spotter satellites, and then we will have the killer satellites. The Administration now says that it would be good to protect our warheads in their hard shells. They have practically given up the notion of population defense. It is unworkable, dangerous and expensive. Why is it unworkable? Because as soon as we have a spotter and killer satellite in space, the Russians will send up small satellites to follow them (Figure 3).

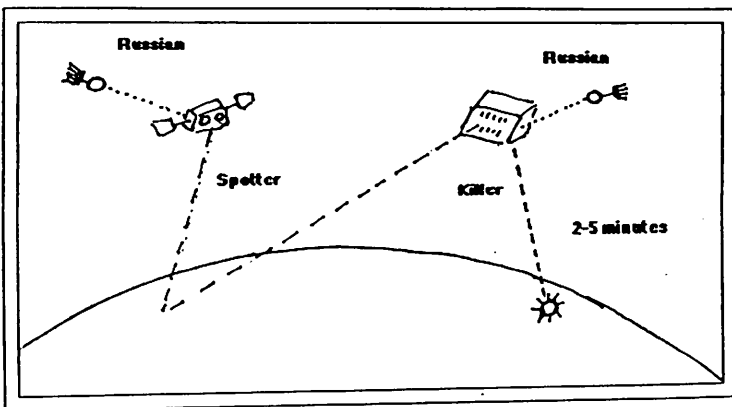


Figure No. 3

If we have a battleship in the Mediterranean, they send a trawler to follow it. We can do nothing about the trawler and nothing about the small Russian satellite that is following us in space. Moreover, the protective shield is not effective because it gives no protection to low flying aircraft that may come in from submarines. They come in under the dome and they cannot be detected in time.

General James Adamson, Director of the Strategic Defense Initiative said: "A perfect astrodome defense is not a realistic thing."

So the man who is in charge has admitted that it is not a realistic thing. Yet, we go on. Why? Here comes the power of the Military Industrial Complex in against which President Eisenhower clearly warned the day before he left office.

The Military Industrial Complex has a momentum of its own. So many of our voting citizens, so many of the lobbyists and so many of the Congressmen are becoming dependent on the enormous amount of monies that are being spent. Once Star Wars is going, it cannot be stopped. Our only chance is that you, the voters of the United States, and you, the visitors of other countries make it known to the Government of the United States that you don't want it.

Artificial Hearts for Short-Term Use. In the near future, artificial hearts as you well know, will be used mainly as a bridge to heart transplantation. There has been an enormous amount of publicity and emphasis on the occurrence of thromboemboli coming from the artificial heart causing strokes. The inside of Dr. Barney Clark's heart was completely clear. I am convinced that Barney Clark had no emboli, but five of the six subsequent patients had.

Emboli can originate from the valves, or from places where the quick connects are inserted in the artificial heart or from the ventricle itself.

Dr. Jack Kolff, successfully implanted an artificial heart without quick connects into a calf at Temple University in Philadelphia on November 22, 1985. To avoid the important source of thrombi that can originate from the valves, you can use tissue valves. Thrombi may originate from the artificial heart itself, particularly from the diaphragm-housing junction. For many years, we have championed the use of a smooth inner surface of the artificial heart (4). This can either be smooth native polyurethane or the polyurethane can be treated with prostaglandin or heparin, or it could be made either hydrophobic or hydrophilic (5). This brings us to the biolyzed inner surface of the artificial heart which has been championed by Dr. Yuki Nose and Dr. Ray Kiraly in Cleveland, Ohio (6).

We can also fall back on the rough intima. When we used Silastic to make artificial hearts many years ago, Dr. Hans Zwart had our first one-week survival when he applied fibrils to the intima of the artificial heart. (7) Indeed, fibrils are still applied on the inside of the artificial hearts being made by Nimbus, Inc (8). Although initially there may be more hemolysis, there is evidence that at least for relatively short periods of time, the fibrin that is formed will not come off and will not form emboli.

I feel the most practical hearts for short-term use are air driven hearts because they are light, inexpensive and you can repair the drive system on the outside.

Artificial hearts can be used to gain time to find a donor heart, or to allow a would-be recipient to recover from a complicating disease such as bronchopneumonia. We have abundant evidence that in our experimental animals, pulmonary congestion and bronchopneumonia can dramatically improve within a few days. The first clinical experience in patients points in the same direction.

Artificial Hearts for Long-Term Use. There will never be enough donor hearts to satisfy the demand. Perhaps we can get 5,000 donor hearts per year. I believe that 45,000 people in the United States would rather have an artificial heart than die. (The official figure is 15,000 - 35,000, people - NIH report).

Philosophers with healthy hearts proclaim that life is not worth living if you are tethered to a small, portable drive system such as the Heimes Driver (9). They forget that these patients are far more mobile than people confined to a wheelchair. The Heimes Driver weighs eight pounds and runs 12 hours before the batteries need recharging.

The Electrohydraulic Heart is being pursued in our laboratory by Dr. Tony Lioi. This has a very small electric motor which pumps hydraulic fluid from the pumping chamber of the left to the pumping chamber of the right and vice versa. We can reverse this motor in fourteen-thousands of a second to go full speed - that is 12,000 revolutions one way to 12,000 revolutions per minute the other way. The driving pump has only one moving part and two bearings. I believe that this is the most practical solution for a totally implanted artificial heart in the near future.

It is lighter and smaller than any of the other artificial hearts now being pursued (10). Dr. Tony Lioi has had a calf in very excellent condition for 28 days. There was perfect balance between the right and left ventricle. This was obtained with a "leaky" pulmonary artery valve. By varying the duration of right diastole, the amount of regurgitation is controlled. No compliance chambers are necessary as in other mechanically driven hearts (Figure 4).



Figure No. 4

(Figure 6 shows the cost of dialysis for one month in 1983.)

Cost Per Month (13 Dialysis Treatments)

	<u>Facility Charges</u>	<u>Physician Charges</u>
Home Dialysis	\$1,430	\$136
Dialysis In-Center	\$1,794	\$193
In Hospital	\$4,225	\$3,250

Figure 6

If the patient treats himself at home, the physician makes \$136. If the patient is treated in a limited care facility, the physician receives \$193. The physician who makes the decision whether or not he will keep the patient in the hospital, makes \$3,000 more if he does keep the patient in the hospital. The difference for the United States Health Provision is \$5,900 per patient. Unless we change these things, we will have the situations that Dr. John Bunker predicted.

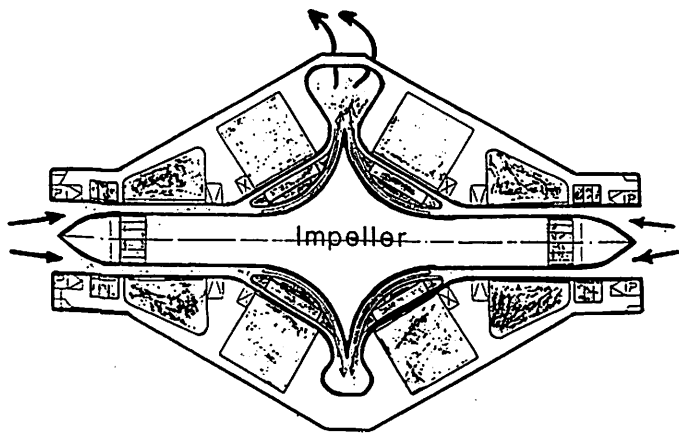
Why would we not have enough money for our citizens in need? Here is the answer.

1986

The military spending:	\$312 billion	39% of income tax to the military
The federal deficit:	\$180 billion	57% for military related spending

One of the reasons for the high cost of defense is the Trident Program. A picture of Trident is shown on the next page.

A little further in the future comes the artificial heart developed by Dr. Don Olsen from Salt Lake City and Dr. Guenter Brann from Germany, which has electromagnetically suspended rotors in the bloodstream. It has no valves and no axles (Figure 5) around which thrombosis can occur.



Longitudinal Section
ELECTROMAGNETICALLY SUSPENDED ROTOR

Figure No. 5

Dr. Don Olsen had the excellent idea to suspend the electromotor and the impeller in the bloodstream by electromagnets. Each pump has only one moving part - the motor and the impeller. It has only electromagnetic bearings. Dr. Paul Hoeller and Dr. Brann have built a working prototype in Germany. Its clinical application is a few years away (11).

If we ever quote the artificial kidney program because it is so expensive, we should first look at why the kidney program is so expensive.

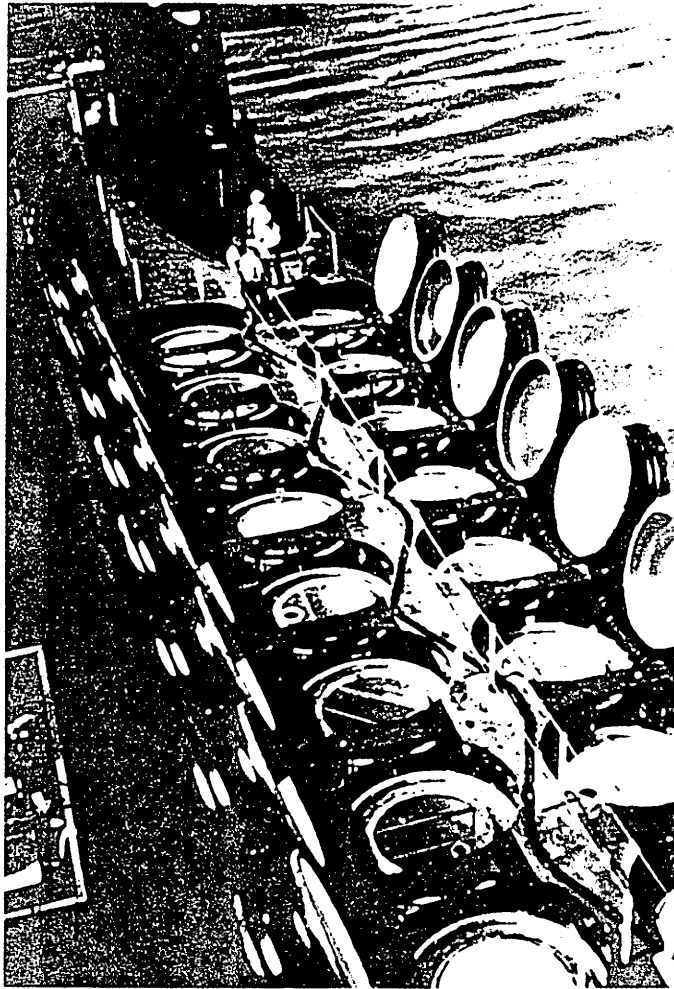


Figure No. 7

Courtesy of the Center for the Consequences of Nuclear War,
1350 New York Avenue, N.W., Washington, D.C. 20005

One can see the rockets in the Trident. They represent eight times the firepower of all the firepower of World War II - enough to destroy all the major cities on the Northern Hemisphere. The cost of the Trident Program is equivalent to 48 percent of the total Social Security Program per year. We are building many more of them right now.

A Capital Levy of 15 percent for all Americans

It seems incredible to me that you want to try to cut the \$180 billion dollar deficit without cutting the \$312 billion dollars for defense. During the five years that the Netherlands were occupied by Hitler's Germany, the national debt of the Netherlands increased five times. At the end of the present Administration's second term, the national debt of the USA will be five times as much as it was when they took office. Do you know what the Dutch did about it? The Dutch had a capital levy and took 15 percent of all the possessions of every Dutch citizen - not of their income, but of their capital. Fifteen percent of the money of every Dutchman was taken to save the State. I would like to see what the reaction will be in the United States when we do that here.

Yet, we allow this to go on. We already have 13,500 nuclear warheads, and today we have built eight more. By 1990 we will have 21,000 more nuclear warheads. What are we going to do with them and the Nimitz aircraft carriers? Nine billion dollars for a Nimitz with its escorts per year! What galls me is that one well-placed exocet or one harpoon can blow a Nimitz to smithereens. So we build more. Congress must regain control and cut the military budget.

Artificial Kidneys. Our WAK (Wearable Artificial Kidney) is now made by the Ube Junken Corporation in Japan under the name PKS Kidney. It is small and battery operated (12,13) (Figure 8).

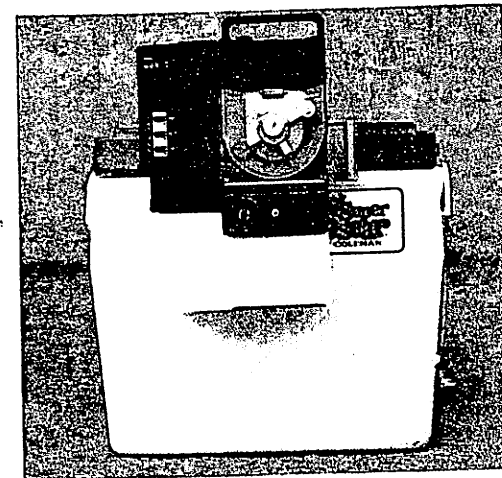


Figure No. 8

Artificial kidneys for chronic uremia are on their way out. The majority of patients should have kidney transplantations. This is wonderful, but there is still a use for small artificial kidneys:

1. For use in the ICU as an ultrafilter. Ultrafiltration will come into an indication of its own in intensive care units for the removal of edema, particularly pulmonary edema in patients who are severely ill and have insufficient renal function.
2. Used in combination with charcoal or other sorbents and with or without very little dialyzing fluid.
3. For plasmapheresis (14). Cascade membrane plasmapheresis can do the same as ordinary plasmapheresis, but much better. It does not run the risk of hepatitis or AIDS.

Dr. Udipi Shettigar recently completed a paper (15) in which he points out that in nearly all so-called controlled studies, the number, duration and intensity of plasmapheresis have not been sufficient to even expect a favorable result. In Europe, the reception of plasmapheresis is far better than in the United States. Dr. Yuki Nose's Department with Dr. Paul Malchesky is clearly the leader in the United States. Dr. Shettigar has recently indicated that after most of the globulins have been separated from most of the albumin of the blood plasma (16), globulins can be further treated with hydrochloric acid and dialysis. The end result is that in certain cases, the antigens can be removed from the immune complexes, but even the globulins can be returned to the patient (Figure 9).

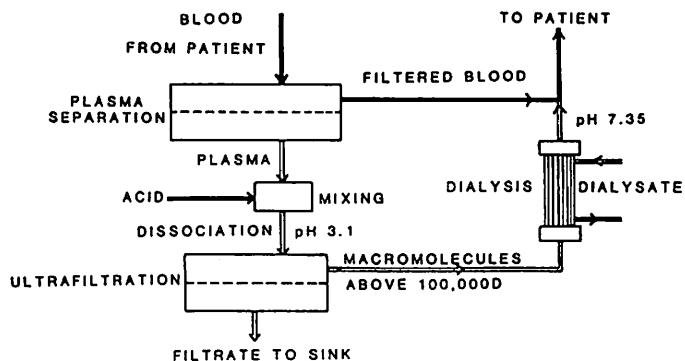


Figure No. 9

Carcinoma Downwind

I want to remind you that here in Utah we have had plenty of cancer as a result of the nuclear testing that went on in Nevada and at the time of writing, is still continuing, although the Russians have instructed a nuclear freeze. Southern Utah is downwind from that test site. When Dirty Harry and ten other nuclear blasts were exploded, about 4,500 sheep died from nuclear fallout. The AEC said it was malnutrition.

Our Research Money goes to Defense

It has been virtually impossible to get money from the National Institutes of Health to make better, smaller and less expensive artificial kidneys. There is no relation at all between the \$3.26 billion dollars spend on end-stage renal disease by Social Security and the few million dollars at most, that NIAMDD can spend towards improving dialysis. The reason of course, is that our research money goes to defense.

Of all the research and development money in the United States, 33 percent goes for the military. Of the federal research and development money in the United States, 70 percent goes for the military.

The consequences of the research money going specifically to defense instead of to industry and science are ominous. For the artificial intelligence (which is a super computer), the United States military will get \$600 million in the next ten years, but only \$100 million will go to industry. To the contrary, Japan will spend \$400 million on artificial intelligence in industry in the next ten years. No wonder they will get ahead of us.

In Japan there is an enormous increase in productivity. All the way at the bottom of this graph, you find the pitiful growth in productivity in the United States. This is because we spend our money on defense (Figure 10).

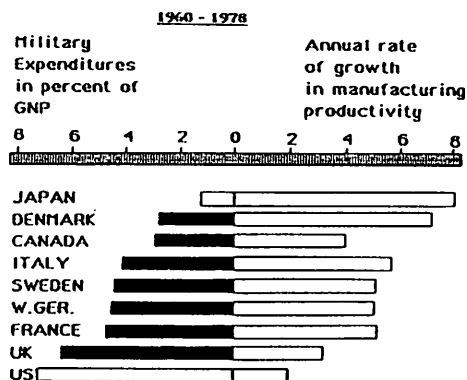


Figure No. 10

Artificial Pancreas. If you inject insulin into the arm or the leg, you are barking up the wrong tree. The Lord wanted the insulin to go to the liver. So you should give insulin either in the portal vein, which I don't know how to do, or you should give it into the peritoneal cavity. Dr. Bob Stephen uses the SPAD (Subcutaneous Peritoneal Access Device) to deliver insulin in the peritoneal cavity (Figure 11).

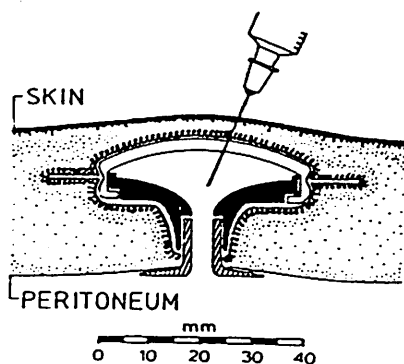


Figure No. 11

At this moment, a young lady came running from the back of the theatre to the stage to show her SPAD in her slender, upper belly. She received a well-deserved applause. The SPAD may be one of the most important things we have ever done in terms of the number of patients who can benefit (17). I have encouraged this program. I have seen many of the 30 patients who have been treated with these SPAD's by Dr. Robert Stephen. I firmly believe that we have the only patients in the world with clinically established diabetic nephropathy who have either remained stable or have improved (18).

The concentration of insulin in the non-diabetic peripheral circulation is much lower than in the portal circulation. The concentration of insulin in the peripheral circulation in patients with diabetes who inject themselves, either in an arm or leg, is relatively high. There is peripheral hyperinsulinemia and portal hyponinsulinemia. If you give the insulin intraperitoneally, 60 to 80 percent of it is absorbed via the portal vein and goes to the liver. The occurrence of peritonitis with the SPAD has been negligible and not serious when it happened. The earlier complications, when the opening towards the peritoneal cavity was overgrown with a pannus, is seen less and less. A simple surgical technique has been developed by which the undesired pannus is removed. This can be done on an outpatient basis.

What is the significance of the SPAD? Eighty percent of what was formerly called juvenile diabetics, now called insulin dependent diabetics, are in trouble by the time that they have had the disease for 20 years. It is not understood why the other 20 percent is free from complications. Close regulation of insulin injected by pumps or otherwise, gives no statistically significant improvement of established degenerative processes that occur in diabetics. The cost to society in terms of dollars is \$6 billion per year in the United States. The cost in human misery is immense.

Now is the time for large scale application of intraperitoneal administration of insulin in all young diabetics. I predict that it will postpone the occurrence of the dire complication of diabetes such as renal disease, blindness, vascular disease, etc. No diabetic patient should receive a kidney transplant unless he also has a SPAD.

During World War II in the Netherlands, I had a ward full of diabetic patients who we could not give as much insulin as they needed. So we starved them, and I was able to give them just enough insulin to stretch their miserable lives until the end of the war. But what do you think will happen to diabetics in case of a nuclear war?

The Nuclear Winter

A Committee of the National Science Council has studied what will happen and has come up with the nuclear winter. Their figures were too optimistic because they had not calculated the dust that is generated when cities are really hit. If cities are hit in the United States, those that survive will try to leave, but the sky will be dark and roads will be clogged. Some will try to go to a farm that they remember. When they get there, they will find that in summer, the crops have died on account of the cold.

Some will go South and in the unlikely case they can get all the way through Mexico and arrive in Central America, they will find that the nuclear winter has killed the tropical forest and that the population there is roaming around trying to keep warm. Some will remember a beautiful lake in Canada and will try to go there to find refuge. When they get there, they will find that the lake is not just frozen with a little ice, but the ice is about twenty feet deep. They will find that all life has ceased and that pretty soon, the trees that were there will catch fire.

What we should do is rearrange our priorities. We should realize that it is totally insane to keep expending more and more money on the military, believing that it buys safety, where in reality, it increases the risk.

President Reagan can stop the Arms Race

Harold Willens wrote a book entitled, *The Trimtab Factor*. He was instrumental in getting the American people to believe that the war in Vietnam should be stopped. He got public opinion to the point where Congress practically forced President Nixon to withdraw our troops if he wouldn't make peace in three weeks. When you go home, ask your representatives to listen and impress your strong feeling upon them that we should change our way of thinking about safety. It is a fallacy that more bombs will give more protection. If you all do that, we can induce President Reagan, who has a better chance than anybody ever had, to deal with the Russians and stop the arms race.

"We can't defend ourselves; the Russians can't defend themselves; there is nowhere to hide." (Admiral Gene LaRoque)

Einstein said, "The atomic bomb has changed everything except our thinking."

So the old way of military thinking in terms of "more weapons give more security", whereas actually, it doesn't make any difference whether we kill the Russians ten times or two hundred times.

In the middle of Figure 12, you see one single dot. This single dot represents the total firepower of World War II. The little dots that you see around it, express the firepower that we have now accumulated. Just imagine what will happen if that is unleashed.

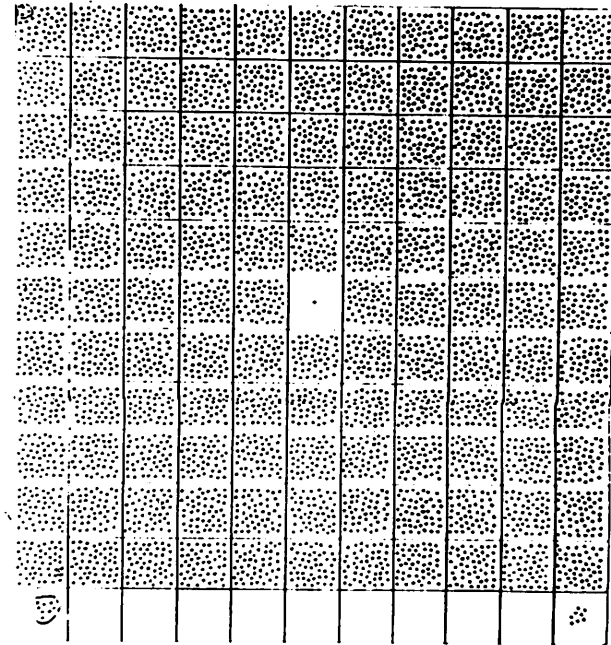


Figure No. 12

In a corner is a little combination. This represents a Trident submarine as shown in Figure 7. It has eight times the firepower of all the firepower of World War II, and it can destroy all important places in the Soviet Union many times over.

In case of nuclear war, we can destroy the Soviet Union and all the cities and worthwhile targets 200 times. We have 14,500 strategic nuclear warheads ready and we make eight more every day. Today, we made eight more nuclear warheads. We have had 36 near misses and in one of them, only the last one of the seven safeguards saved us from a nuclear explosion. We already have a degree of overkill that is incredible. With every additional warhead, the chance of M.A.D. (Mutually Assured Destruction) accidentally or otherwise, increases.

Dialysis of Schizophrenics. On April 27, 1978 I presided over a meeting at the American Society for Artificial Organs to discuss the treatment of schizophrenia by dialysis (19).

Schizophrenia is a confused compilation of terrible mental illnesses. Drs. Robert Cade and Herbert Wagemaker had obtained some very encouraging results with dialysis, particularly in some young women. Dr. Roberta Palmour claimed to have found a chemical variation of the usual endorphin in the dialysate. This made me very interested. Dr. Robert Stephen calculated from her data how high the endorphin levels in the blood would be to find the amount that she claimed to have found in the dialysate, and there is no doubt that her data are wrong.

However, schizophrenia is favored by hereditary factors. I like the assumption that schizophrenia may have a metabolic origin. There is a chance that a least some acute forms of schizophrenia could be treated. Membranes used for plasmapheresis or sorption methods seem to be more promising than dialysis membranes.

There is anecdotal evidence that patients, particularly young women, treated without any success with the best presently available therapy, have benefitted considerably from a regime of which dialysis was a part. In those cases where success was seen, the most striking change was that it became more possible to communicate with the schizophrenic. I was pleased to induce Dr. Splendiani from L'Aquila, Italy to come here and discuss his results at this meeting.

It may be difficult to change schizophrenics. It seems to be equally difficult to change those dependent on the military industrial complex. Yet, I do not want you leave this meeting without hope.

In a democratic society, we are able to influence our government. Harold Willens, the author of the book, *The Trintab Factor* (20) has done that before. Harold Willens helped sway public opinion to abandon the war in Vietnam. He succeeded to obtain a 55 percent approval for the nuclear freeze when it was put on a ballot in California. If with your help, we can strengthen the movement which is called BENS, we may force the government to a nuclear freeze. We must get a majority in the Congress.

Six leaders of other countries in five continents have had the nerve to speak out that we should change our thinking and before anything else, stop the threat of nuclear war. I don't think they trust the Russians and I don't trust them. Things have changed - we can detect a nuclear explosion anywhere. Nobody can hide it anymore. We can see a delivery missile anytime it's fired anywhere in the world. In other words, we can monitor whether or not the others keep their word or cheat.

So when you go home join:

Business Executives for National Security, Euram Building,
21 Dupont Circle, N.W., Suite 401, Washington, D.C. 20036

International Physicians for the Prevention of Nuclear War,
225 Longwood Avenue, Room 240, Boston, MA 02115

Physicians for Social Responsibility, 639 Massachusetts
Avenue, Cambridge, MA 02139

Beyond War, 222 High Street, Palo Alto, CA 94301

Center on the Consequences of Nuclear War, 1350 New York
Avenue, N.W., Suite 300, Washington, D.C. 20005

And let your voice be heard.

This is the time to deal with the Russians because the balance is about right (Figure 13).

CURRENT STRATEGIC FORCES	
ESSENTIAL EQUIVALENCE	
U.S.	U.S.S.R.
TOTAL LAUNCHERS 2059	TOTAL LAUNCHERS 2500
TOTAL THROWWEIGHT 7.2 MILLION LB.	TOTAL THROWWEIGHT 10.8 MILLION LB.
TOTAL WARHEADS 9550	TOTAL WARHEADS 4950

Figure No. 13

Do you remember that Sadat came to Israel only when he felt that his honor was restored after they had crossed the Suez Canal. You cannot come to an agreement with the Russians if you are far superior. Then they will feel compelled to compete. Notwithstanding the propaganda of the Military Industrial Complex, we are about balanced. (Honestly, what difference does it make whether we can destroy each other 100 times or 1,000 times?) So when you go home, please drive safely, but more importantly when you go home, join one of these societies and make it so that we are not all vaporized. Because when we are vaporized what good will an artificial heart do you? In a democratic society we can force our government. It is up to you (21-31).

Acknowledgments

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24. Center for Defense Information, 303 Capitol Gallery West, 600 Maryland Ave., S.W., Wash., D.C. 20024
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POSTSCRIPT

Don E. Detmer

You have just been treated to a unique human experience. That was a Willem Kolff lecture and it was a classic--creative, articulate, timeless, wise, challenging, witty, and always, always positive at the bottom line. I hope over the next days and months you savor this moment when you have a chance. Thank you, Dr. Kolff, for being with us and sharing those views.