National Museum of Health and Medicine

Otis Historical Archives

OHA 220.07
MacNeill Collection

Accession Number: 2014.0006

Date of Records: 1951-1955

Size: 2 boxes

Finding Aid by: Eric W. Boyle (2014)

Background Note: The advent of kidney dialysis had a powerful impact on the postwar generation of researchers, transforming the field of medical engineering and encouraging efforts to devise mechanical aids for other physiological function, including those of hearts and lungs. Dr. Arthur E. MacNeill, a physician and engineer, coined the term "therapeutic engineering" to describe his are of interest and special concern in this burgeoning field of research and design. MacNeill sought to apply physiological principles to the instrumentation used in clinical medicine. He believed that such instrumentation should be defined in terms of its function, rather than as an "artificial organ." MacNeill had designed his first blood pump while he was still a medical student in 1933. He had received funding from the United States Army to adapt his blood pump for kidney dialysis, and in the early 1960s, a dialysis machine that he had developed came into wide use because it was portable and did not require an external pump. MacNeill had designed it to utilize the natural pumping action of the artery to which it was connected. Subsequently, in accordance with his view of therapeutic instrumentation, MacNeill proposed, with a grant from the Hartford Foundation, to develop and build improved pumps and oxygenators that would aid the heart and lungs temporarily during congestive heart failure and other disabling heart and lung conditions. His group would also develop improved blood dialyzers to treat uremia, edema, and systemic poisoning, and to aid kidneys affected by heart failure or other ailments. Finally, MacNeill's team also attempted to construct bedside monitoring devices for blood pressure, pulse rate, temperature, respiration, and other vital signs. By 1962, MacNeill's team had adapted his machine for the treatment of congestive heart failure and edema. The group also drew on this technology to create an environment for organs that was similar enough to the natural environment to preserve the organ until it could be transplanted. Unfortunately, the Buffalo General Hospital where MacNeill undertook his research underwent a reorganization shortly thereafter that left MacNeill without the staff support he needed to carry out clinical trials of the instrumentation he and his colleagues had developed. Subsequently, he left the hospital and established his own Dialysis Research Institute.

Series/Scope and Content Note: Dialyzer prototypes designed and built by MacNeill between 1952 and 1954 are housed in the NMHM's Historical Collections. The Research and Development Division of the Office of the Surgeon General, U.S. Army, funded the development of this device under contact DA-49-007-MD-475, as the use of the artificial kidney by the 11th Evac Hospital in Korea proved the value of this

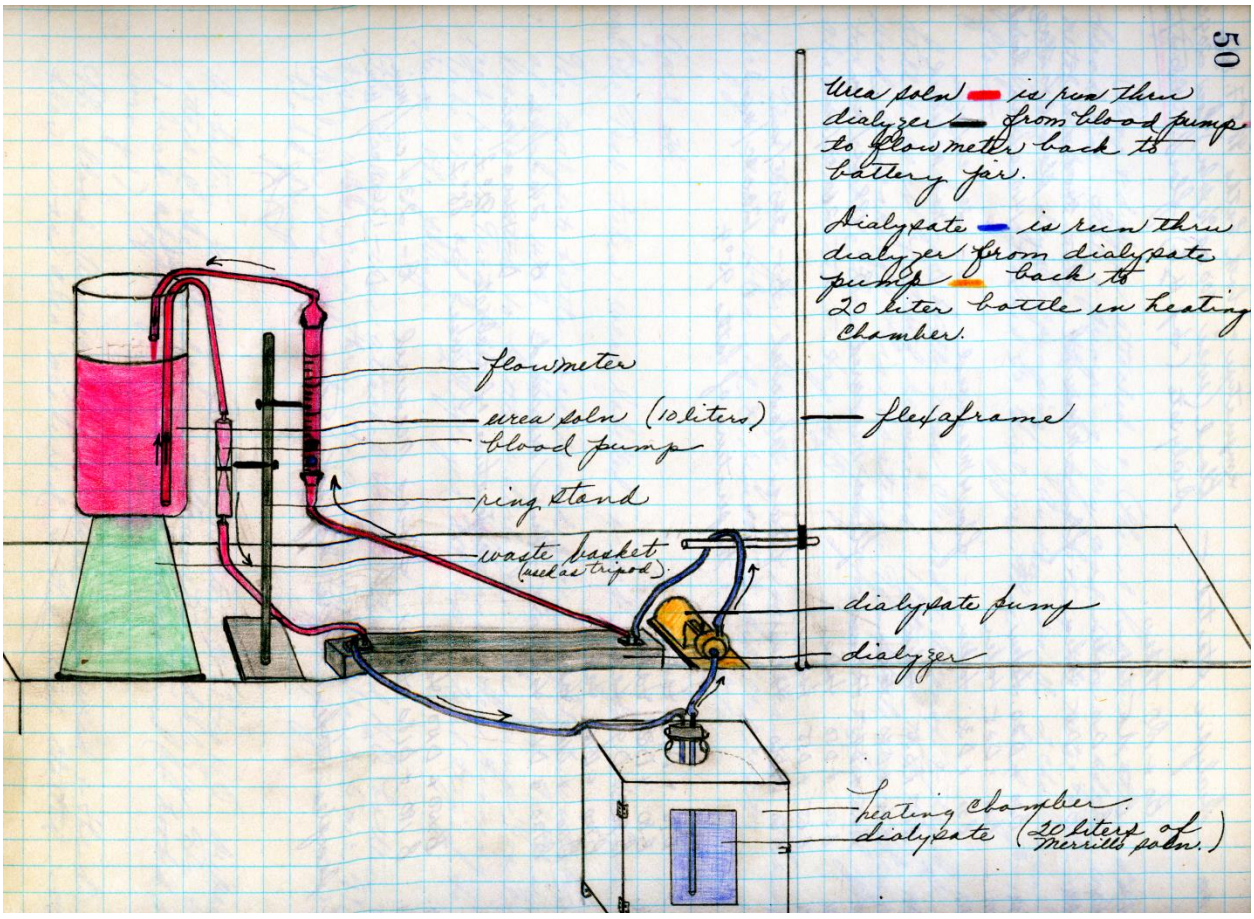
new technology, but remained cumbersome under field conditions. The MacNeill device was compact, easier and quicker to clean, and had a less complex design. OHA 220.07 consists of three notebooks that describe the development, testing, and operation of the device, along with outcomes from preliminary research. The design was ultimately put in production as the MacNeill-Collins dialyzer and used to a limited extent during the Vietnam Conflict between 1968 and 1969.

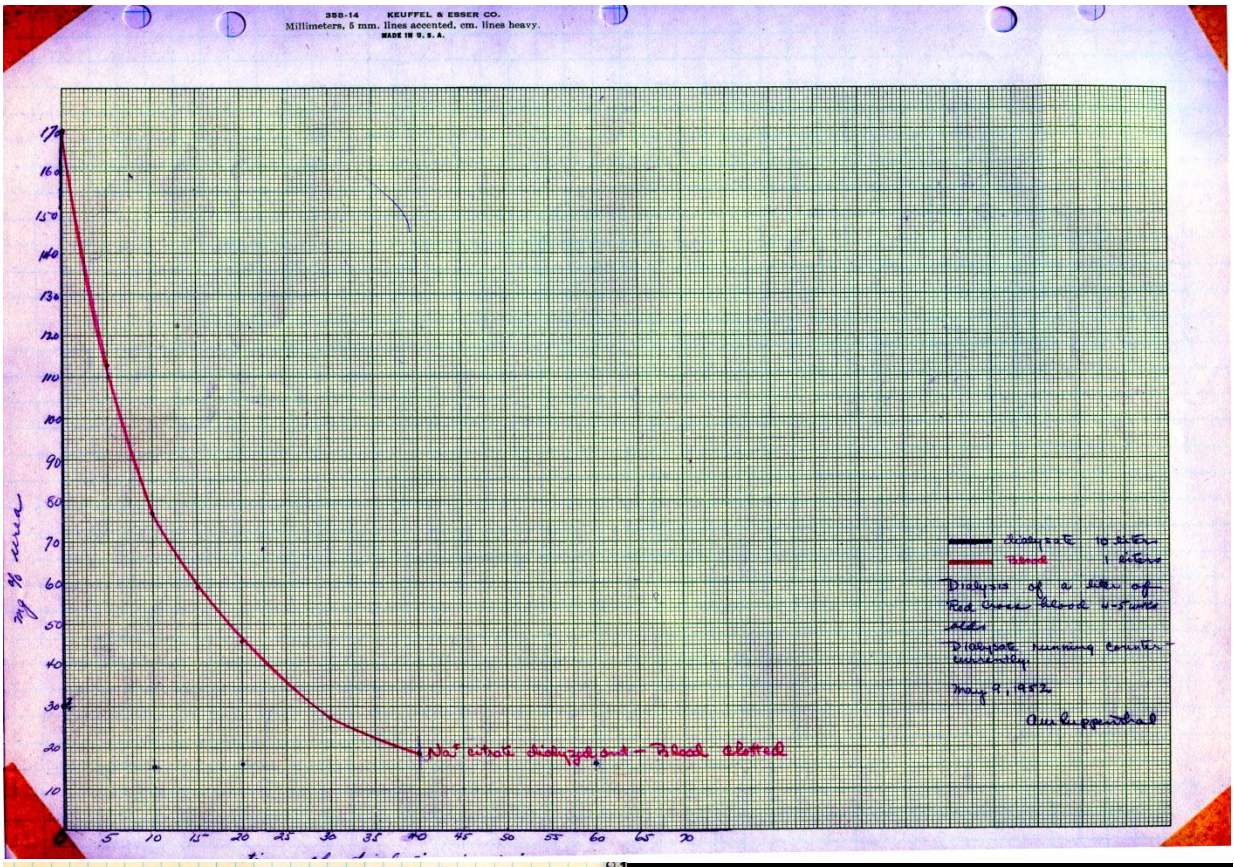
BOX AND CONTENT LIST

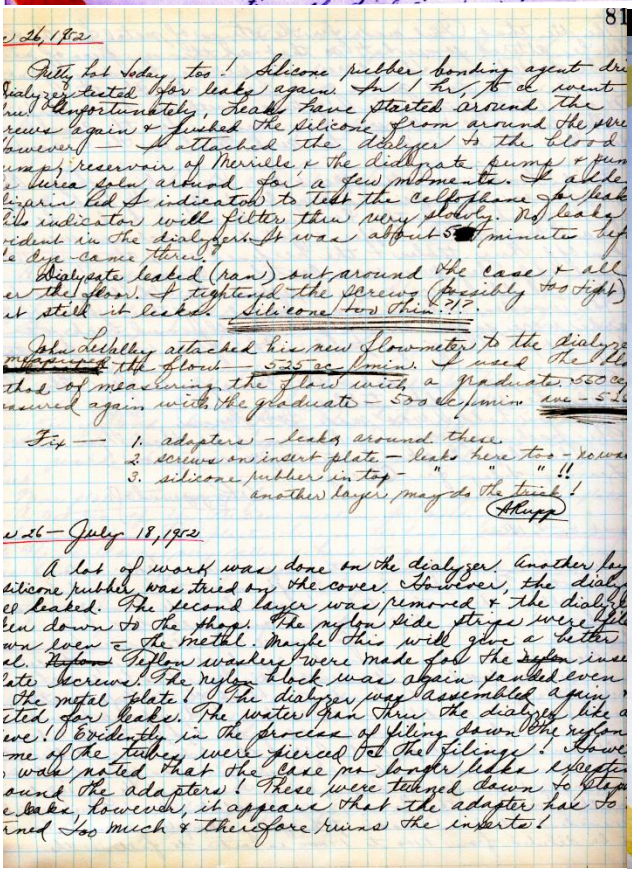
Box 001: Three Research Notebooks

1. "Dialyzer Book" (151 pp.)

    - This notebook begins on August 2,1951, with notes and drawings of the dialyzer design. Subsequent notes, drawings, and graphs relate to research and development for the period ending August 14, 1953.







81

26, 1952

Pretty hot today too! Silicone rubber bonding agent dri
Dialyzer tested for leaks again. In 1 hr, 15 cc went
thru. Unfortunately, leaks have started around the
screws again & pushed the silicone from around the scre
However — I attached the dialyzer to the blood
pump, reservoir of Merrills & the dialyzate pump & pum
the urea soln around for a few moments. I adde
Lizarin Red S indicator to test the cellophane for leak
This indicator will filter thru very slowly. No leaks
evident in the dialyzer. It was about 5 minutes bef
the dye came thru.

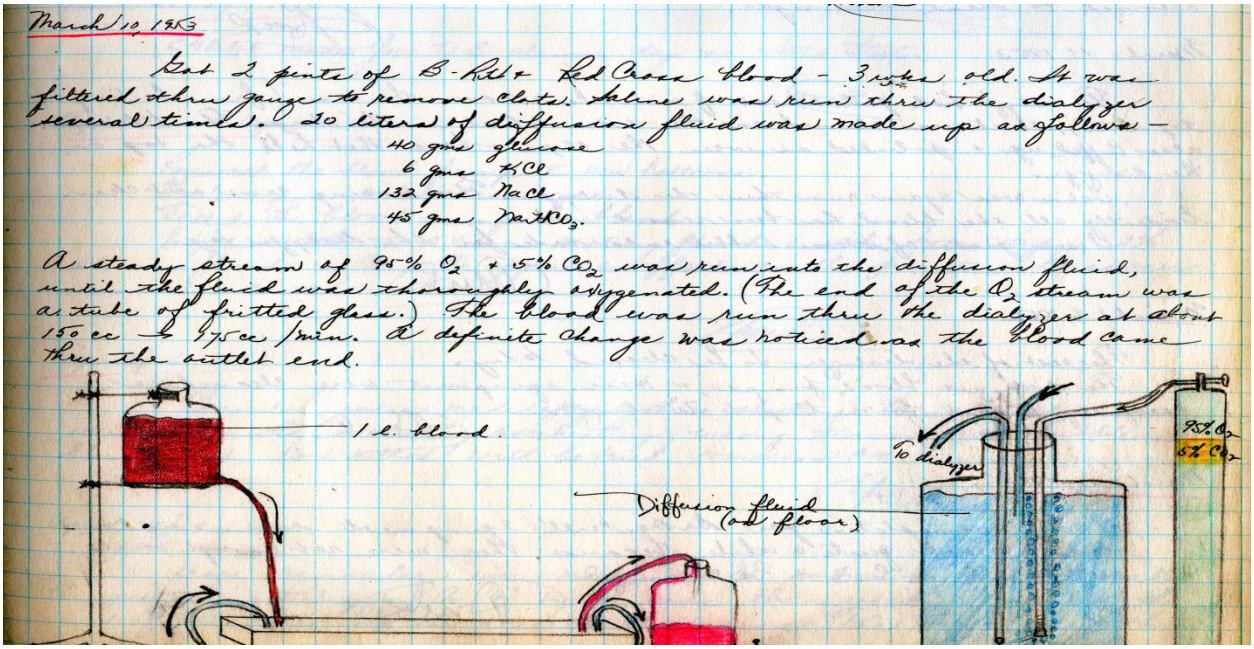
Dialysate leaked (ran) out around the case & all
over the floor. I tightened the screws (possibly too tight)
but still it leaks. Silicone too thin?!?

John LeValley attached his new flowmeter to the dialyze
measured the flow — 525 cc/min. I used the bl
method of measuring the flow with a graduate. 550 cc
measured again with the graduate — 500 cc/min. ave — 5

Fix — 1. adapters — leaks around these.
2. screws on insert plate — leaks here too — no wa
3. silicone rubber in top — " " " !!
another layer may do the trick!
(A Rupp)

26 — July 18, 1952

A lot of work was done on the dialyzer. Another lay
silicone rubber was tried on the cover. However, the dialy
leaked. The second layer was removed & the dialyz
taken down to the shop. The nylon side strips were fil
down even to the metal. Maybe this will give a better
seal. ~~Nylon~~ Teflon washers were made for the ~~nylon~~ inse
plate screws. The nylon block was again sanded even
the metal plate! The dialyzer was assembled again
tested for leaks. The water ran thru the dialyzer like a
sieve! Evidently in the process of filing down the nylon
some of the tubes were pierced to the filings! Howe
it was noted that the case no longer leaks except
around the adapters! These were turned down to stop
the leaks, however, it appears that the adapter has to
turned too much & therefore ruins the inserts!


March 10 1953

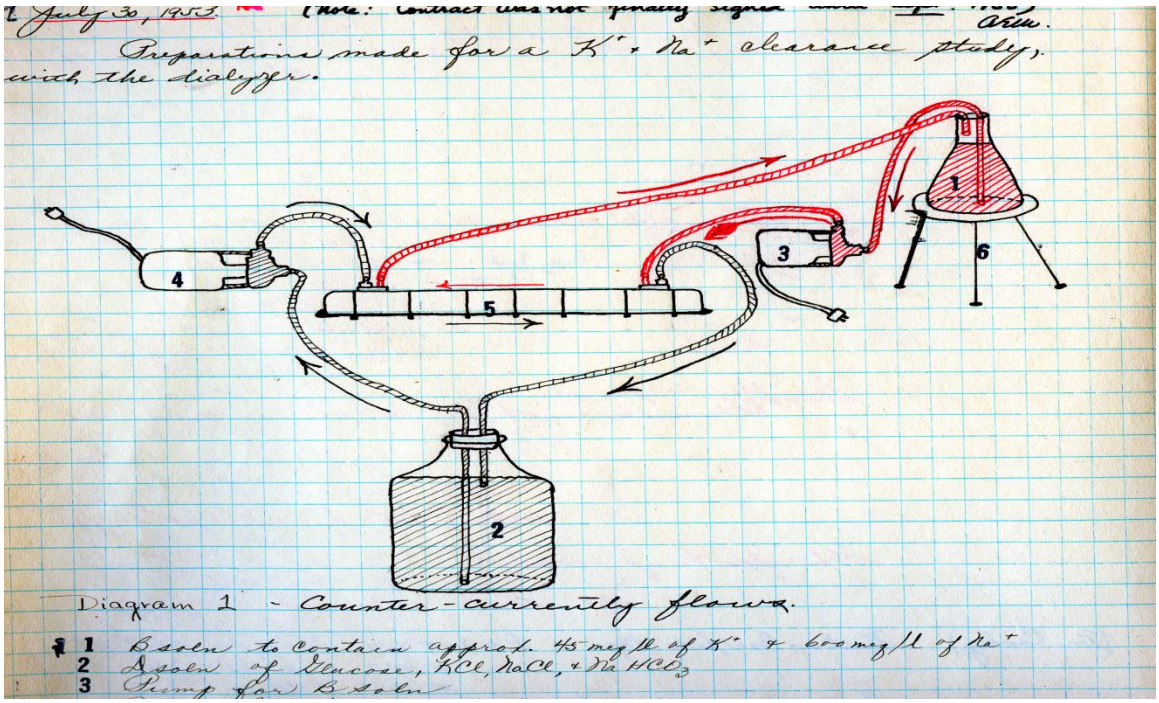
Got 2 pints of O-Rh+ Red Cross blood - 3 wks old. It was filtered thru gauze to remove clots. Saline was run thru the dialyzer several times. 20 liters of diffusion fluid was made up as follows –

40 gms glucose
6 gms KCl
132 gms NaCl
45 gms $NaHCO_3$.

A steady stream of 95% O_2 + 5% CO_2 was run into the diffusion fluid, until the fluid was thoroughly oxygenated. (The end of the O_2 stream was a tube of fritted glass.) The blood was run thru the dialyzer at about 150 cc → 175 cc / min. A definite change was noticed as the blood came thru the outlet end.

2. "U.S. Army I" (152 pp.)

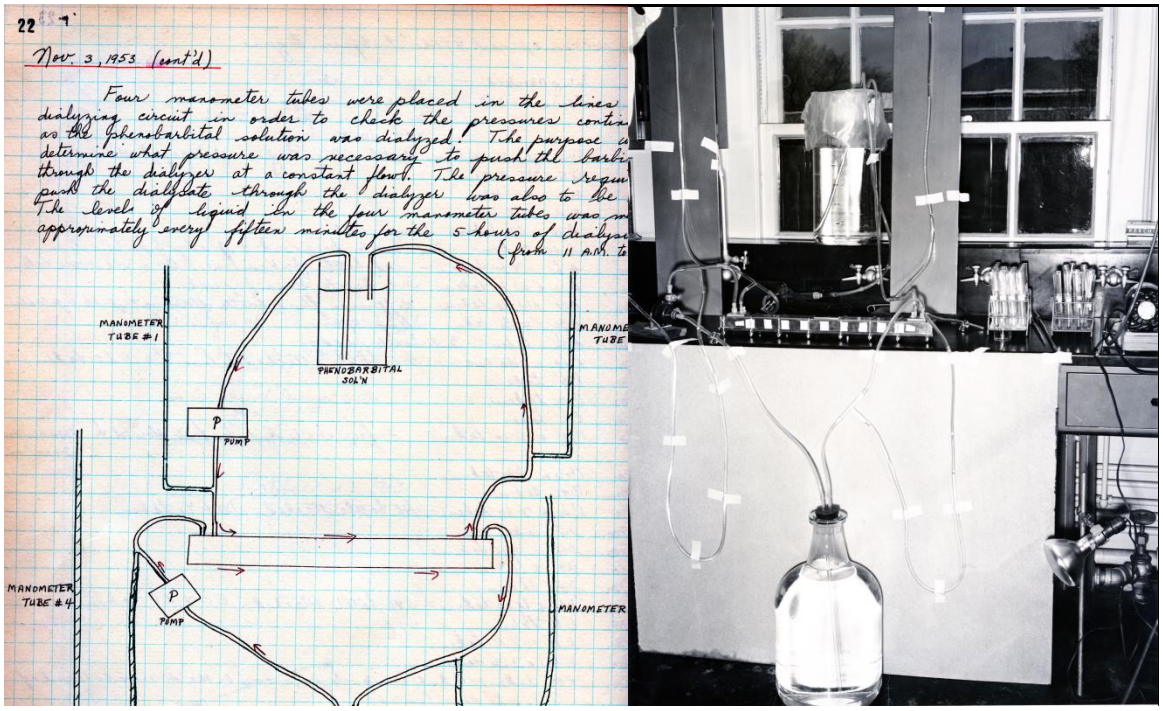
   - This notebook contains work records of a military-type dialyzer beginning July 30, 1953. Notes, drawings, graphs, and reports relate to research and development of the machine for the period ending December 29, 1954. The notebook also includes photographs of the dialyzer and an exhibit on the application of a blood dialyzer. Additional restricted material includes clinical photographs and clinical data on the application of the blood dialyzer in human subjects.

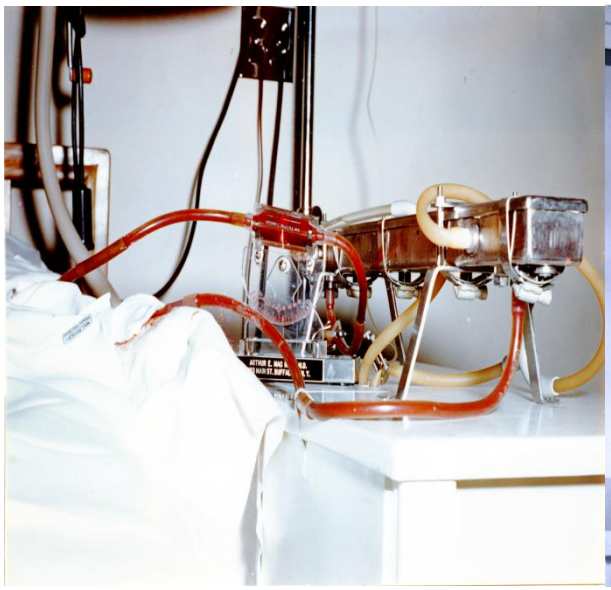

July 30, 1953

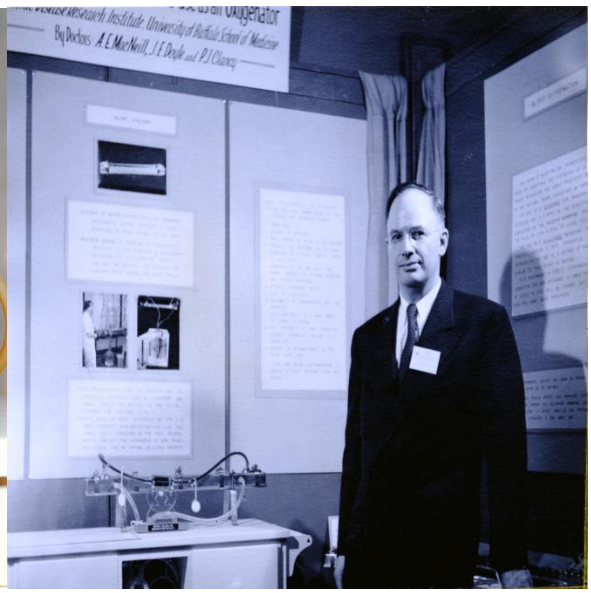
Preparations made for a K^+ + Na^+ clearance study with the dialyzer.

Diagram 1 - Counter-currently flows.

1 B soln to contain approx. 45 mg % of K^+ + 600 mg % of Na^+
2 A soln of Glucose, KCl, NaCl, + $NaHCO_3$
3 Pump for B soln







3. "U.S. Army II" (107 pp.)

   - This notebook contains work records of a military-type dialyzer beginning January 1, 1955. Notes, drawings, graphs, and reports relate to research and development of the machine for the period ending December 31, 1955. The notebook also includes a large number of restricted clinical photographs and clinical data (including diagnostic information, case histories, pathological reports, protocols, and checklists) related to the application of the blood dialyzer in human subjects.

Box 002: Photographs from Posters (see Oversize for details)

00001: Research Uses Placard
00002: Laboratory Scenes
00003: Test of Cellophane vs. Teflon
00004: One Tube Dialyzer
00005: Three-tube Dialyzer-Oxygenator
00006: Cross Dialysis Studies
00007: Kidney Perfusion with Dialyzer-Oxygenator
00008: O2 and C02 Exchange for a Fish
00009: Oxygenator Studies
00010: Clinical Applications Placard
00011: Diagram with Machine and Patient
00012: Vein-to-Vein Blood Dialysis, 1956 to Date
00013: Ultrafiltration for Heart Failure, 1956
00014: Ultrafiltration, 1963
00015: Dialyzer in Pump-Oxygenator, 1959
00016: Dialysis of Transfusion Blood, 1949 to Date
00017: Protein Salvage from Urine
00018: Protein Salvage from Alscitic Acid

Oversize Materials (C22-7-B-6):

00001: "A New and Simplified Blood Dialyzer System," Arthur E. MacNeill (title board)
00002: "Blood Dialyzers, Blood Oxygenators, and Blood Pumps," Arthur J. MacNeill and John E. Doyle (Title Board and 5 additional Boards)
00003: 3 Boards from Poster Sessions