



# National Museum of Health and Medicine

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## 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 area 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 contract DA-49-007-MD-475, as the use of the artificial kidney by the 11<sup>th</sup> Evac Hospital in Korea proved the value of this



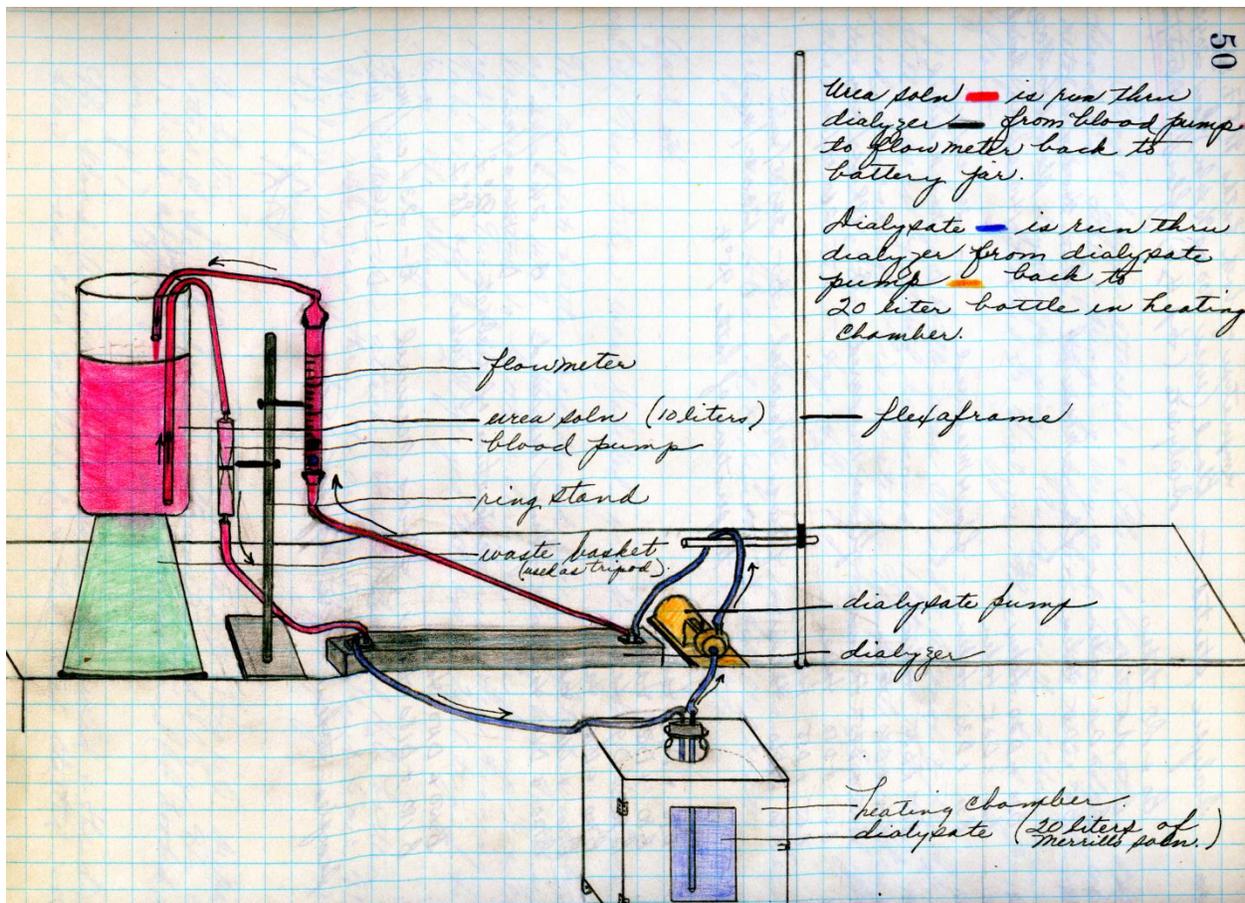
new technology, but remained cumbersome under field conditions. The MacNeill device was compact, easier and quicker to clean, and had a less complex design. OHA 220.07 consists of three notebooks that describe the development, testing, and operation of the device, along with outcomes from preliminary 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.

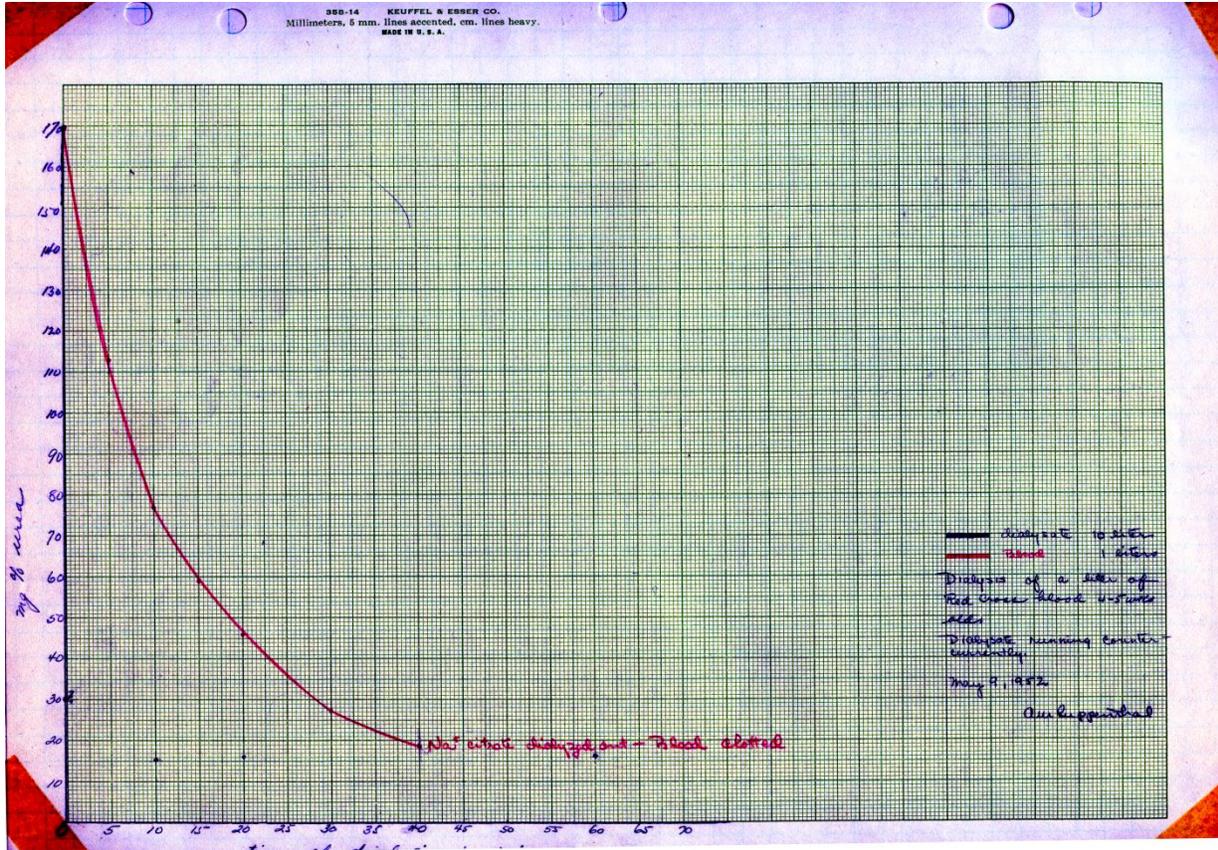
## BOX AND CONTENT LIST

### 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.





26, 1952

Pretty bad today too! Silicone rubber bonding agent did  
not protect from leaks again. In 1 hr. to 2 hours  
and unfortunately, leaks have started around the  
seals again & pushed the silicone from around the  
seals - I attached the dialyzer to the blood  
wrap reservoir of Merrill & the dialyzer pump & run  
a urea soln around for a few moments. I made  
ligature lid (indicated) to hold the cellophane for peak  
the indicator will filter thru very slowly. No leaks  
red in the dialyzer. It was about 5 minutes before  
a dye came thru.

Dialyzer leaked (ran) out around the case & all  
at the floor. I tightened the screws (possibly too tight)  
it still it leaked. Silicone too thin?

John Shelby attached his new flowmeter to the dialyzer  
measured the flow - 525 cc/min. I used the old  
one of measuring the flow with a graduate - 550 cc  
measured again with the graduate - 525 cc/min use - 525

Fix -  
1. adapters - leaks around these.  
2. screws on insert plate - leaks here too - screws  
3. silicone rubber in top - " " " "  
another layer, maybe the trick!  
(Shipp)

26 - July 18, 1952

A lot of work was done on the dialyzer. Another layer  
of silicone rubber was tried on the cover. However, the dialyzer  
is leaked. The second layer was removed & the dialyzer  
was down to the shop. The nylon side strips were held  
in even - the metal. Maybe this will give a better  
seal. Nylon yellow washers were made for the nylon in  
the screws. The nylon block was again scuffed even  
the metal plate! The dialyzer was assembled again &  
it did not leak. The water ran thru the dialyzer like a  
run! Evidently in the process of filing down the nylon  
one of the tubes were pierced (at the filings)! I saw  
this, noted that the case no longer leaks except  
around the adapters! These were taken down to shop  
to be taken, however, it appears that the adapter has to  
be used too much & therefore ruins the inserts!

81

GREEN BASE	BROWN BASE
Green - 30 seconds	Brown - 30 seconds
Red - 15 seconds	Red - 15 seconds
Blue - 15 seconds	Blue - 15 seconds
Orange - 30 seconds	Orange - 30 seconds
Black - 15 seconds	Black - 15 seconds
Chartrreuse - 30 seconds	Chartrreuse - 30 seconds
Purple - 15 seconds	Purple - 15 seconds
Brown - 30 seconds	Green - 30 seconds



March 10 1953

Got 2 pints of B-Rite Red Cross Blood - 3 wks old. It was filtered thru gauze to remove clots. Solns 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  $\text{NaHCO}_3$

A steady stream of 95%  $\text{O}_2$  + 5%  $\text{CO}_2$  was run into the diffusion fluid, until the fluid was thoroughly oxygenated. (The end of the  $\text{O}_2$  stream was a tube of fritted glass.) The blood was run thru the dialyzer at about 150 cc - 475 cc/min. A definite change was noticed as the blood came thru the outlet end.

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

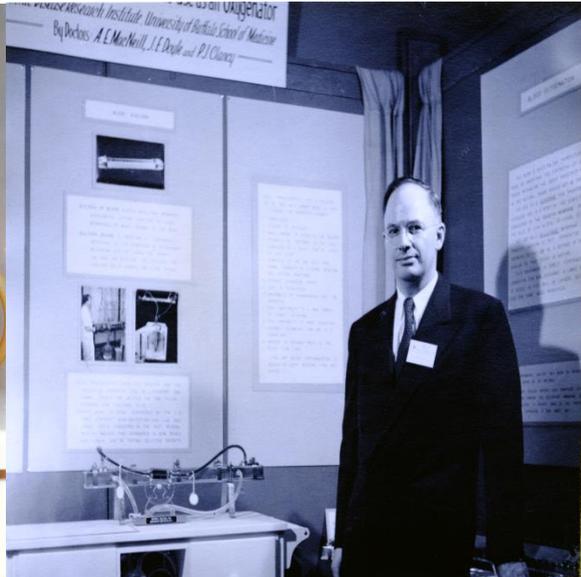
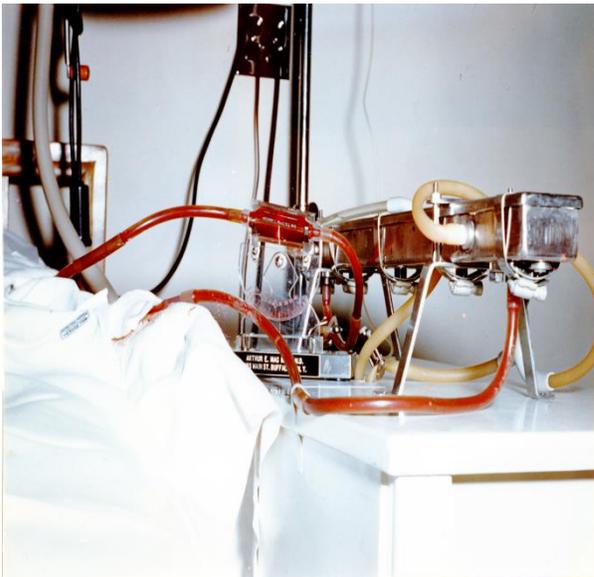
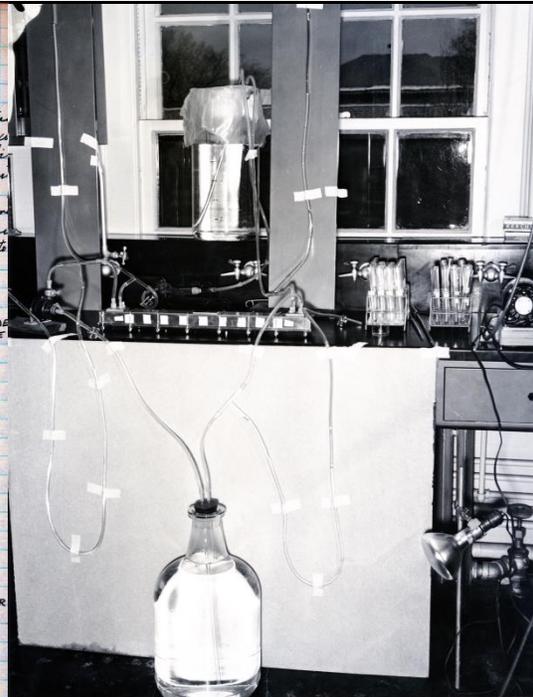
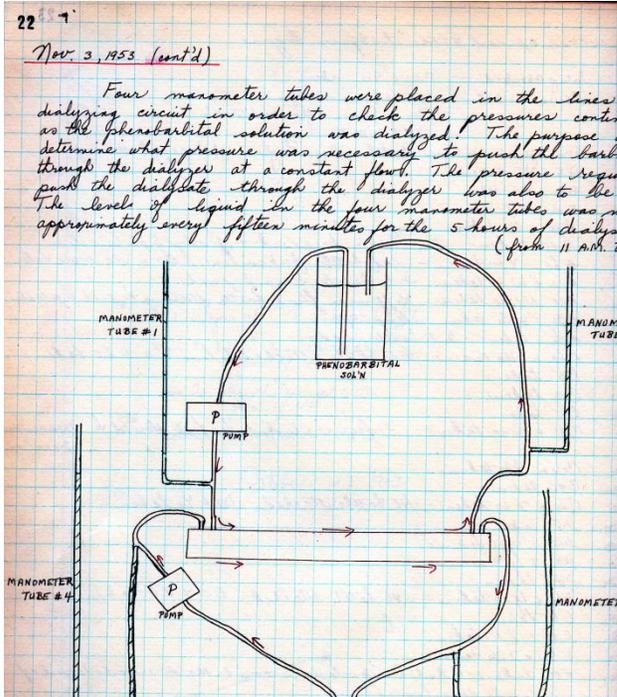
- This notebook contains work records of a military-type dialyzer beginning July 30, 1953. Notes, drawings, graphs, and reports relate to research and development of the machine for the period ending December 29, 1954. The notebook also includes photographs of the dialyzer and an exhibit on the application 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 (Note: contract was not finally signed until 1954.)

Preparations made for a  $\text{K}^+$  +  $\text{Na}^+$  clearance study, with the dialyzer.

Diagram 1 - Counter-currently flows.

1 Reservoir to contain approx. 45 mg/l of  $\text{K}^+$  + 60 mg/l of  $\text{Na}^+$   
2 Reservoir of glucose, KCl, NaCl, +  $\text{NaHCO}_3$   
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: O<sub>2</sub> and CO<sub>2</sub> 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