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authority of Paul B. Dowd, Jr. 6/26/70
by Alberta V. Weidner 7/15/70
Reviewed by Paul B. Dowd 8/8/79

M. M. Haring
Laboratory Director

ELECTRONICS PROGRESS REPORT

Josef W. Heyd
Section Chief

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Date: November 1-30, 1948

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~~Prepared by L. B. Gragoy~~
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<u>GENERAL PROBLEM</u>	<u>SPECIFIC PROBLEM</u>	<u>MAN MONTHS</u>	<u>JOB CLASSIFICATION</u>	<u>GROUP NO.</u>	<u>PAGE</u>
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2. Determination of Efficiency of Electrostatic Shielding	1. Testing of Shielded Rooms (Mound Laboratory)	1	S-209	9	
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ELECTRONICS SECTION

J. W. Heyd and P. E. Ohmart

ABSTRACT

Group 9

The work to determine the feasibility of a practical solution counter for alphas has been continued through this month. It has developed that the electronic technique using an Amperex mica-window GM tube (1.4 mg./cm² mica) is reliable, and it now appears that the problem is mainly one of solution-mounting technique. Two problems have occurred and are as follows:

1. Evaporation of the solvent has caused an increase in the number of counts within a ten minute period. This was eliminated by the use of rubber hydrochloride over the solution to prevent evaporation.

2. Inconsistencies in the counting rate have occurred and may be attributed to variations in the thickness of the rubber hydrochloride in contact with the solution, the possibility of an absorption phenomenon at the junction of the rubber hydrochloride and the solution, and the inability to maintain solution levels accurately due to slight bulging and sagging of the rubber hydrochloride.

The latest solution-mounting technique is to pipette 10 ml. of solution into the Lucite solution holder. A Lucite ring, to which is mounted a sheet of rubber hydrochloride, is then placed over the solution holder but does not make contact with the solution. This method, at first, appeared very consistent and reproducible, but later tests indicated that there might have been absorption in the new pipette used to fill the solution container.

Group 3 is continuing to work out a solution-mounting technique. Group 9 has designed a solution counter patterned after a photographic enlarger. The GM counting tube is fixed in position above a movable platform, with a swing of 3 3/4" to allow for future mounting of the solution in a cylindrical rather than a dish container. A scale calibrated in hundredths of an inch is mounted on the rear of the solution counter. This unit is now under construction.

Group 10

Two four-input gamma mixers and three two-input B-wall mixers have been given a final check and assembled in cabinets with their associated scalars. These scalars, Instrument Development Laboratory Model 161-S, were modified for use with either type mixer and may also be used for straight GM counting.

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Installation of a light shield on the Underwater Electrometer eliminated most of the back reflection which had made reading of the scale difficult.

Investigations have been made concerning the possibility of constructing portable pulse generators which do not rely upon calibration against an oscilloscope.

Group 11

One Instrument Development Laboratory Model 161-S, scale of 256 gamma counter has been given performance tests before being placed in operation at Mound Laboratory. Results show that these scalers are satisfactory for our use. Relocation of the "Scope" jack is recommended since the circuit is loaded appreciably when one's hand comes in contact with this jack.

Tests are being run on the parallel plate alpha counter Model K-262, made by the Kelley-McCott Manufacturing Company. These tests are not complete, but results obtained thus far indicate that some modifications are needed before the instruments are satisfactory for use.

The central wire of the methane-flow chamber, which gave faulty operation on the Logac-L at Unit IV, was found to be coated with a white substance thought to be a polymer of methane. Positive identification of this material has not been made.

An RF high-voltage power supply is being designed and constructed for Group 4. The purpose of this power supply is to ionize a small sample of unknown vapor in a quartz tube in order to analyze the vapor spectroscopically.

Group 12

Except for minor details, the induction heaters located in the "Y" Section of the "P" Building are ready for operation.

Two four-input gamma counters, and three two-input B-wall counters are available for installation.

Instruments for the "WD" Building have been installed and are being checked.

Group 13

Two new instruments were set up and checked. A check of the effect of a collision film on alpha counts indicated that the film does not lower counts.

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Group 14

Routine counting was carried on as usual.

Group 25

It was necessary to re-determine the geometry on Logac-B. One group of slides counted on the parallel plate alpha counters indicated that a collodion film lowered the count from .04 to 7.4 per cent.

DETAILED REPORT

Group 9 - P. E. Ohmart, W. H. Baker, M. D. Birkhold, J. H. Hutchinson, F. J. Shepherd, and J. S. Stanton

The need for a solution counter for alphas came about because of the difficulty experienced by Group 3 in evaporating a sulfuric acid solution of radioactive elements onto glass slides. To determine the feasibility of solution counting, it was necessary to have an experimental setup whereby it would be possible to vary the distance between a mica window GM counting tube and the solution to be counted. This was accomplished initially by mounting the solution holder on some brass shims and placing it under the counting tube which was mounted on a ring stand. The distance was varied by removing the .008" shims (see Figure 9-1). The first difficulty encountered was an increase in the number of counts due to the evaporation of the solvent. This was remedied by filling a Lucite dish with the solution and covering with rubber hydrochloride in contact with the solution.

With this arrangement, it was possible to obtain data from which to draw a graph of counts per minute versus distances between the counting tube and the solution level. This data indicated that there was a drop from an initial rate of 650 counts per minute to 300 counts per minute in a space of .2".

Some difficulty in obtaining consistency and reproducibility was traceable to three causes:

1. Unequal levels of the solution which would cause the rubber hydrochloride to bulge or sag.
2. Variation in the thickness of the rubber hydrochloride.
3. The possibility of an absorption phenomenon when the solution was allowed to be in contact with the rubber hydrochloride for any length of time.

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EXPERIMENTAL ARRANGEMENT OF SOLUTION COUNTER

Figure 9-1

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To overcome these conditions, it was decided that a fixed amount (10 ml.) of solution would be pipetted into the solution holder so that the level of the solution was below that at which it would contact a piece of rubber hydrochloride placed on top of the solution holder. The rubber hydrochloride was stretched on a Lucite ring so that it might be used repeatedly. In the first experiments with this new technique, the first two solution fillings gave results which were consistent and reproducible within the limits of statistical accuracy. The third, fourth, and fifth fillings deviated considerably in the direction of increased counts. Preliminary speculation as to the aforementioned deviation has been directed toward the possibility of absorption in the new pipette used in filling the solution holder.

It seemed reasonable from the data obtained in the past month, that electronically, the method employed was consistent and reliable when using an Amperex mica window GM tube (1.4 ng./cm.² mica). On this premise, Group 9 started the design and construction of a solution counter to be mounted in a lead cylinder, so as to hold the gamma background to a minimum. At the same time, Group 3 continued experiments to determine a satisfactory technique of filling and checking the solution container. The solution counter now in the process of construction is patterned after a photographic enlarger. The GM counting tube is stationary and a movable platform, on which the solution container is mounted, moves up and down under the counting tube by rotation of a small knob. The maximum movement of the platform is 3 3/4". This will provide for a change from a dish-type solution holder to a cylindrical-type solution holder. A scale calibrated in hundredths of an inch, with a vernier scale calibrated to allow for interpolation to one-thousandth of an inch, will be mounted at the rear of the solution counter.

Group 10 - C. E. Hites, W. B. Adams, H. L. Cook, Jr., A. D. Flaughner, J. L. Gregg, Jr., R. E. Hemmer*, E. C. Hoelzle**, M. B. Lambert, G. A. Preston, E. Robinson*, D. E. Santi, F. M. Teetzel**

* Transferred to Electronics Stock Group November 1, 1948.

** On loan from Group 11.

The four-input gamma mixers, EL-208 and EL-246, and the two-input B-wall mixers, EL-226, EL-244, and EL-245 were rechecked and assembled in cabinets with their associated scalers, Instrument Development Laboratory Model 161-S. The scalers were modified by adding an auxiliary connector on the rear apron of the chassis and tapping directly to the high-voltage rectifier cathode to provide high voltage to the mixers. As a result of tests made on this model scaler, the "Scope" jacks on the front panel were moved to a spot on the chassis near the distortion amplifier (see Detailed Report of Group 11). The scalers as modified may be used with either the two-input or four-input mixers, as well as for straight GM counting.

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6J4 tubes are being tried in the two-input mixers as high-voltage series regulators. The 6C4 tubes originally installed have a tendency to arc over when sufficient voltage is applied to reduce interaction of the two high-voltage controls to a minimum.

Construction on another four-input gamma mixer, EL-247, has been started and is approximately fifteen per cent complete.

The portable regulation checker, EL-258, was completed. Construction drawings and parts lists are being checked for accuracy and completeness. Photographing of the unit is scheduled for December 1, 1948.

Wiring of the "Model" plating control, EL-215, a high current unit, was completed. Photographing of this unit is also scheduled for December 1, 1948.

Wiring and rough tests of the scaler-multiplier, EL-251, were completed, and an Instrument Development Laboratory Model 162 scaler is being modified for use with the multiplier.

A light shield, which was installed on the control panel of the Underwater Electrometer, eliminates most of the back reflection which had made the projected scale difficult to read. Causes of the zero drift of the scale have not been definitely determined, but appear to be caused by distortion due to temperature changes of the aluminum construction supporting the optical system. Figures 10-1 and 10-2 show the installation of the Electrometer.

Investigations have been made concerning the possibility of constructing portable pulse generators which do not rely upon calibration against an oscilloscope. The basic circuit for controlling and measuring the peak pulse voltage is shown in Figure 10-3. E_{in} is a negative pulse of relatively constant amplitude, although constant amplitude is not a requirement for satisfactory operation. The amplitude of E_{out} is controlled by the variable voltage in series with the diode. Theoretically, when this voltage is zero, the output will be zero because the diode will conduct at all values of E_{in} and short the pulse to ground (assuming zero resistance of the voltage source). If the voltage is increased to some value, such as two volts, the plate of the diode will then be two volts negative with respect to the cathode. The diode will not conduct until E_{in} has a value of two volts; therefore, the amplitude of E_{out} is two volts. The amplitude of E_{out} is measured by the meter connected as shown.

In the practical form, the control-indicator circuit is fed by a cathode follower to minimize loading of the pulse-generating circuit and

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Figure 10-1

UNDERWATER ELECTROMETER

OPERATING POSITION SHOWING POWER SUPPLY AND VACUUM CONTROLS

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FIG. 10-1 MLM 236

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Figure 10-2

UNDERWATER ELECTROMETER

GENERAL VIEW OF INSTALLATION WITH SLUG HOLDER IN POSITION

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FIG. 10-2

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Figure 10-3 Basic Circuit for Controlling and Measuring Peak Pulse
Voltage of Generator

terminates in a decimal attenuator. Design sketches have been made and construction has been started on a prototype instrument, EL-261.

Group 11 - L. B. Gnagey, W. A. Dean, K. H. Gregersen, D. I. McKee, R. L. Shipp, Jr., and T. L. Zinn

The Model 161-G, scale of 256, gamma counter was given performance tests pending the use of these scalers at Mound Laboratory. The following are the results of tests run on counter USA No. 14378:

1. The input sensitivity of the scaler is adjustable from -.15 to -.75 volts (60-cycle frequency synchronizing pulse generator).

2. Sensitivity of scaler set at -.25 volts (no scope attached):

Follows to 150 kilocycles with pulse generator set at -.25 volts.

Follows to 200 kilocycles with generator set at -.55 volts.

3. Effect of loading when oscilloscope is attached to "Scope" jack:

Follows to 150 kilocycles with pulse generator set at -.35 volts.

Follows to 190 kilocycles with pulse generator set at -.6 volts.

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4. Effect of loading with hand on "Scope" jack:

Follows to 150 kilocycles with pulse generator set at -.6 volts.

Follows to 200 kilocycles with pulse generator set at -1.5 volts.

5. Effect of loading with hand from "Scope" jack to ground:

Requires over -6 volts at all frequencies.

6. With the high voltage turned off, there is a line pick-up of 60-cycle frequency at the GM input, or the high voltage output, of .02 volts peak to peak. This ripple is not increased with the high voltage turned on.

7. Regulation of high voltage supply:

Output set at 500 volts: No perceptible movement of pointer of electrostatic voltmeter with the input voltage to the scaler varied from 65 to 130 volts.

Output set at 750 volts: No perceptible movement of pointer of electrostatic voltmeter with the input voltage to the scaler varied from 65 to 130 volts.

Output set at 1,000 volts: No perceptible movement of pointer of electrostatic voltmeter with the input voltage to the scaler varied from 80 to 130 volts.

Output set at 1,250 volts: No perceptible movement of pointer of electrostatic voltmeter with the input voltage to the scaler varied from 100 to 130 volts.

8. Low voltage supply: 250 volts unregulated.

9. Construction throughout is good and all parts are mounted for relative ease of replacement. Leads are numbered, which should provide more ease in circuit tracing. All high voltage leads are rubber covered, test-lead type wire. Both sides of the AC line are fused and are broken by the master switch. There is a GM input on both the front and rear and a high voltage output on the rear. The AC line cord is not removable.

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It is recommended that the "Scope" jack be disconnected or re-located due to the loading of the scaler when this jack is touched. Since the count switch is located almost beside the "Scope" jack, an erroneous count would result if this jack were touched while attempting to turn the count switch off.

The input circuit of this scaler is a distortion amplifier, and it may be desirable at some later date to change this to a trigger-pair type input.

A parallel plate alpha counter Model K-262, manufactured by Kelley-Koett Company of Covington, Kentucky, has been received for testing. These tests are not complete, but results obtained so far indicate that several changes will have to be made before the instrument will be completely satisfactory. One very undesirable characteristic is that with the timer actuated by the "Count" switch, many counts are thrown on the counter by turning the "Count" switch to the "On" or "Off" position. These spurious counts are due, at least partially, to the fact that there is no filter across the timer contacts of the "Count" switch. A complete report will be compiled after completion of the tests.

Plateaus have been run on the four Amperex mica-window beta and alpha counting tubes. Using a beta sample, the 100C tubes (3.5 mg./cm.² mica) gave plateaus with approximately a ten per cent slope over 300 volts. This agrees favorably with the plateau claimed by the manufacturer. Using an alpha sample, both the 100C and the 200C tubes (1.4 mg./cm.² mica) showed plateaus with approximately a two per cent slope over a 400 volt range. These results indicate that the Amperex tubes are superior in performance to the Victoreen tubes which we have been using. A suitable chamber using an Amperex tube is being designed as a permanent setup for beta counting.

The methane-flow chamber, which gave faulty operation on the Logac-L at Unit IV was inspected under a microscope and the central wire was found to be coated with a white substance, which is suspected to be a polymer of methane. The probability of polymer formation is substantiated by the article, "A Study of the Deterioration of Methane-Filled Geiger-Mueller Counters" (Earle C. Farmer and Sanford C. Brown, from The Physical Review Volume 74, No. 8, dated October 15, 1948).

Work is being done for Group 4 on a high voltage, high frequency power supply which will ionize a small sample of unknown vapor in a quartz tube in order to analyze the vapor spectroscopically.

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A Tesla coil (radio-frequency leak-detector) ionized the vapor readily, but the ionization fluctuated too greatly for use in the spectrograph. Two 60-cycle transformers, the first of 4500 volts RMS, and the second of 12,500 volts RMS, were tried but neither produced sufficient ionization.

The RF high-voltage power supply for the Model 248-A DuMont oscilloscope was then used as the voltage source and worked quite satisfactorily. The RF voltage between the electrodes clamped on the quartz tube was approximately 10,000 volts RMS at a frequency of 280 kilocycles. Ionization appeared to be complete, since the light from ionization did not increase when a Tesla coil leak-detector discharge spike was brought close to the quartz tube.

An RF power supply similar to the oscilloscope supply is being designed and constructed for this work.

Group 12 - W. L. Mead and E. K. Daggett

The nine induction heaters located in the "Y" Section of the "T" Building are ready for operation with the following exceptions:

1. Two sets are out of commission pending the arrival of replacement rectifier tubes. The defective tubes are being returned to the factory. Plugs for connecting the induction heaters to the power lines have not been received.

2. Further adjustment is required on the Ratosight flow meters used in conjunction with the induction heaters. New Mercoid units were received to replace those now in use but they were of the wrong type. Modifications will continue when the correct ones are received.

The lead chambers for use with the four-input gamma counters have been modified to hold cable connectors and the connectors have been mounted. Two four-input gamma counters and three two-input B-wall counters are available for installation.

The panel-mount Wizard registers for use with the Instrument Development Laboratory Model 161-S scalers have been received. These registers are being mounted in a separate box, since there is insufficient room to incorporate them on the front panel on the scalers.

Cables for the two-way speech amplifiers for Group 17 have been made up. Installation of the cable has not been possible since this particular area has been blocked off while the air conditioning system was being checked.

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Instruments for the "WD" Building have been installed and are being checked. These instruments include two Micromax pH recorders, two Micromax indicating and recording pH controllers, four Brown recording electronic flow meters, and one Micromax temperature-indicating recorder.

Group 13 - M. L. Curtis

An Instrument Development Laboratory Model 162, scale of 128, dual-input counter has been set up in Laboratory 27 to facilitate experimental work on an immersion counter being done by Group 34. The immersion counter is located in Laboratory 28 and is connected to the scaler in Laboratory 27.

One of the Kelley-Koett alpha scalers, Model K-262, was checked for several days. It counted standards consistently and had a low resolving time ($\tau = 2.34 \times 10^{-6}$).

Checks were made in an effort to determine whether further work was required on the effects on alpha counts of covering samples with collodion film. The results of counting one group of samples at Unit IV before and after collodion was added, indicated that the collodion used was lowering the count. Solutions of collodion were obtained from both Units, and eleven samples were made up to check the effect of collodion on parallel plate alpha and logac counts. The Unit III collodion did not affect the counts in any way, and the only effect of the Unit IV collodion was to increase the parallel plate alpha counts. The Unit IV collodion was found to be contaminated. Details of this work are contained in a report to E. A. Waldfogle from M. L. Curtis, dated November 24, 1948.

Group 14 - C. A. Brenneman, D. M. Barkalow, J. F. Hunt, E. L. Hyso, and G. L. Wright

The counting load this period (October 27 to November 27, 1948 inclusive) was as follows:

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<u>Instrument</u>	<u>No. of Chemist's Samples</u>	<u>No. of Counts on Chemist's Samples</u>	<u>No. of Std. Counts</u>	<u>No. of Bgr. Counts</u>	<u>Total</u>
Simpson			585	26	611
Alpha Monitor	163	163			163
Parallel Plate Alpha	328	408	1248	97	1753
Logac	173	185	779	218	1182
Logac-L			142	52	194
Solution Counter			50	4	54
Beta			<u>114</u>		<u>114</u>
Total	664	756	2918	397	4071

Group 25 - S. M. Bond, M. N. Kaffenberger, E. E. Koenig*, W. L. Littleton,
A. M. Muldoon, M. N. Morgan, M. V. Owen, L. A. Vendt, R. A. Watrin**

* Transferred from Accounting - November 1, 1948

** Leave of Absence to December 27, 1948

It was necessary to clean the methane gas chamber on Logac-B, and it was discovered that one of the holes in the brass plate was partially covered with grease. It was assumed that the grease had been present when the geometry factors for the instrument had been determined. New factors were determined, and were found to be lower on the four-hole positions.

A group of nine slides counted on the parallel plate alpha counters before and after collodion was put on the slides indicated that the collodion used cut out from .04 per cent to 7.4 per cent of the alpha counts (average - 6.08 per cent).

The counting load this month (October 27 to November 29, 1948, inclusive) was as follows:

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<u>Instrument</u>	<u>No. of Chemist's Samples</u>	<u>No. of Counts on Chemist's Samples</u>	<u>No. of Std. Counts</u>	<u>No. of Bgr. Counts</u>	<u>Total</u>
Parallel Plate Alphas	755	901	914	201	2016
Logac	1519	1540	523	223	2286
Logac-L	<u>979</u>	<u>1974</u>	<u>245</u>	<u>208</u>	<u>2427</u>
Total	3253	4415	1682	632	6729

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