Minutes of the Meeting of
Subcommittee on Instruments and Techniques
of
Committee on Nuclear Science
of the
National Research Council
at
National Bureau of Standards
Washington, D. C.

1178 #2

NAV1.941208.055

Members Present.

William Elmore, Swarthmore College
A. H. Jaffey, Argonne National Laboratory
R. J. Moon, University of Chicago
K. Z. Morgan, Clinton Laboratory
M. Sands, Massachusetts Institute of Technology
E. Steinberg, Argonne National Laboratory
V. C. Wilson, General Electric Research Laboratory (Chairman)

Also Present:

Prof. R. C. Gibbs National Research Council
L. F. Curtiss, National Bureau of Standards
R. L. Butenhoff, Representing A. Dahl, Oak Ridge
H. H. Goldsmith, Brookhaven National Laboratory

Meeting convened 9:30 A.M., Wed. April 28, 1948

The organization of the committee on Nuclear Science and its subcommittees was reviewed. Each subcommittee has the power to decide upon its scope of activities. It has been recommended that this subcommittee

1. Set up minimum specifications for certain types of instruments. Particularly radiation monitoring instruments of the Health Physics Type.

2. Prepare a manual on Instruments and Techniques.

In the discussion that followed it was apparent that most of the members felt that there was a need for item 1. H. ... Parker, F. R. Shonka, J. Rose and W. C. Peacock were absent. Since these men are particularly interested in this Subject it was decided to take no action at this time

The members present believe that there is a need for the handbook Since they felt more qualified to discuss the handbook, the remainder of the meeting was spent on item 2.

There was a general agreement that the handbook be at the graduate level of Physics and Chemistry. It should be a working handbook designed for presentation of useful techniques. Each author should be identified with his contribution, and held responsible for the statements within his section.

Many medical men and biologists do not have the required background to use a book at the graduate level of chemistry and physics. It was suggested that the subcommittees on Radiobiology and Radiogeology be urged to prepare introductory material to give men in these fields adequate background information to use the proposed handbook.

In a discussion of a sample section of the handbook it was pointed out that an introductory paragraph is needed for each section before presenting the working formulae and graphs. Care should be taken to handle nomenclature in accordance with standard usage. In contrast to a text book, the most complete and most general formulae, data and curves should be included It was suggested that for completeness copies of manuscript be sent to all committee members for comment.

H. H. Goldsmith, chairman of subcommittee on publication outlined publication plans. The National Research Council will publish any part of the handbook as a "quickie" as soon as it is ready. These "quickies" would be mimeographed or lithographed for quick distribution in limited numbers. Publishers believe that such "quickies" would not destroy the demand for the finished handbook and would enable one to revise the handbook according to the experiences learned in the use of the "quickies."

It was recommended that all sections of the National Research Council Handbooks have a uniform cover or binding style so that an individual copy would be recognizable as a member of the entire N.R.C. series.

Professor Gibbs mentioned that no individual royalties will be given. Usually the N.R.C. accepts no royalties until after the publisher has met his expenses. This enables the N.R.C. to keep the prices of its publications at a minimum.

It was recommended that whenever possible the material be copyrighted by the N.R.C. at the "quickie" stage. Professor Gibbs pointed out that before a publisher will handle the final volume a copyrights release must be obtained from each author.

The working outline of the handbook was reviewed in detail. The revised outline is included with these minutes.

It was suggested that recommendation be sent to the subcommittee on nuclear constants to issue tables of radioisotopes according to energies, type of radiation, etc.

Meeting adjourned at 5:00 P.M.

OUTLINE FOR HANDBOOK OF NUCLEAR INSTRUMENTS

AND TECHNIQUES

(Revised at Subcommittee meeting April 28, 1948)

I. Detection of Nuclear Radiations

1. Characteristics of nuclear radiations
   - A Disintegration laws
   - B Counting Techniques. Laws of Statistics. Correction factors
   - C Fission fragments
   - D Alpha radiation
   - E Protons
   - F Mesons
   - G Beta Particles
   - H Gamma rays
   - I Nomograph giving mass of particle in terms of cloud chamber data
   - J Neutrons
     1. Rules of thumb for slowing down
   - K Neutrinos

2. General Types of Instruments
   - A. Ionization Chambers
     1. D. C. measurements
     2. Pulse counters (no amplification in chamber)
   - B. Proportional counters and Geiger counters
   - C. Crystal counters
   - D. Electron Multipliers
   - E. Cloud chambers
   - F Photographic films
   - G. Fluorescent counters

3 Electronic equipment
   - A. D. C. amplifiers
   - B. Pulse amplifiers
   - C Pulse height selectors
   - D Scalers
   - E Rate meters
   - F Timing circuits
   - G Multi-channel systems
   - H Coincidence and anti-coincidence circuits

II Techniques in Nuclear Physics

1 Techniques used for heavy particle detection
   - A Protons
   - B. α particles
   - C Heavier nuclear fragments

2 Beta ray detection

3 X-ray and γ -ray detection

4 Neutron detection

5 Nuclear disintegration into stars

6 Neutron detection

7 Applications of coincidence measurements (α, β, γ, etc.)
   - A Decay Schemes
   - B. Use with accelerator research

8 Special techniques associated with monochromatic positive ion accelerators.
9 Special techniques associated with cyclotrons.
10. Special techniques associated with electron accelerators and gamma ray machines.
11. Magnetic moment techniques
A Molecular beams
B. High frequency resonance technique
12 Pile neutron research techniques
13. Beta ray and gamma ray spectrometers
14. Alpha ray spectrometers
15 Mass spectrometers

III Special techniques in radiochemistry

(Alpha emitters as against beta and gamma emitters sometimes constitute different sorts of problems in radiochemistry and measurement techniques These differences should be discussed, where appropriate, under each heading.)

1. The Radiochemical laboratory
a. Cleanliness (re-use of equipment, cleaning equipment, contamination, design of laboratory and type of
b.
2. Preparation of samples for irradiations
a. Pile irradiations
(1 Solids (Radiation chemistry - change of structure with irradiation and possible difficulty in getting into solution).
(2) Liquids and solutions radiation chemistry-formation of oxygen and hydrogen from water
(3) Gases (Flow systems)
(4) Thick and thin samples - effects of shadowing and absorption
(5) Choice of container - resistance to embrittlement and excessive activation. Effect on neutron flux
(6) Build up of activity of fissioned materials for various irradiation and decay times

b. Cyclotron and other accelerator irradiations
(1)
(2)
(3) as in (a)
(4)
(5)
(6) Cooling of target and choice of compound used, etc

3. Preparation of irradiated sample for analysis and purification
a. Solution of sample - (care to dissolve recoils imbedded in sample wrapping)
b. Take account of possible change in oxidation states after irradiation. (Possibility of Szilard-Chalmers reaction)

4. Techniques in chemical analysis and purification
a. Chemical procedures for cyclotron targets and pile irradiated materials

b Carrier techniques (isotopic, non-isotopic and "hole-back")
c. Use of "scavenging" precipitations
d. Decontamination factors
e. Problem of exchange with carriers
f. Tracer preparations (i.e., carrier-free activities)
g Techniques in handling radioactive gasses
h Use of absorption columns and organic solvent methods of purifications.

5. Use of tracer chemistry for investigating specific chemistry of the tracer nuclide.
6 Ultra micro chemical Techniques
7 Chemistry with macro-amounts of radio-elements (methods as they are different from ordinary chemical techniques)
8 Hot lab techniques (remote control apparatus) to carry out same activities as in 3, 4, 5
9 Preparation of samples for counting (mounting techniques)
a Preparation of "weightless" samples
(1) On thick backings
(2) On very thin backings
b Macroscopic samples (precipitates, ignited oxides, etc.)
10. Counting techniques
a. Choice of instrument (on basis of sensitivity, specific activity required, ease of operation, etc.)
(1) GM counter
(2) Current ion chamber
(3) Proportional counter
((4) Pulse ion chamber
b State of sample
(1) Gas samples (gas cells, gas counters for C^{14}, S^{35}, etc.)
(2) Liquid samples
c. Determination of type of radiation (α, β, β', X-ray, conversion electron)
d. Energy determination
(absorption curves, etc.)
e. Determination of half-life
(simple case and case of mixtures, etc.)
f Determination of absolute counting rates
(1) Corrections for scattering, and absorption
(2) Geometry determination
(3) Disintegrations per particle emitted (decay schemes)

11 Criteria of radiochemical purity
a Constant specific activity on recycling
b Radiation characteristics and half-life

12 Some nuclear properties
a Establishment of genetic relationships
b Fission yields
c Mass assignments
(1) From Bohr-Wheeler energy calculation
(2) From fission yields
(3) Cross-bombardments
(4) From genetic relationships

IV Special techniques in radiobiology
1 Techniques of standardization
a. Extrapolation chamber
b. Micro densitometer
c. Scanning detectors for alpha, beta and gamma rays.
d. Methods for the determination of detector geometry.

2. Ionization chambers.

a. 4π insertion chamber for betas and gammas from animals.
b. Small spherical chambers for imbedding in animals.
c Ionization chambers for self beta rays such as carbon 14
d. Gamma ray chambers for external use.
e Ionization chambers for the radioactive analysis of breath and other excreta.
f. Chambers for detection of neutrons.

3 Geiger-Muller counter techniques as used with biological material
a. Internal sample
b External sample
c Mica window counters and thin-walled glass counters and end-window counters.

4. Chambers for measuring the amount of air ionization produced by radioactive materials in the lungs.

5. Fluorescent crystal detectors for alpha, beta and gamma radiations and neutrons.

6. Techniques for measuring neutron doses.

V. Tracer techniques
1. Radioactive tracers
2 Special isotope tracers

VI. Health Physics: Techniques of personnel monitoring and radiation surveying.

Appendix I - Isotopes practical to obtain