

SCIENCE

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Editorial	Thar's Gold in Them Bills	1597
Articles	International Geophysical Year: <i>H. Odishaw</i>	1599
	The first of a two-part summary of IGY activities covers studies of the sun and upper atmosphere.	
	The Industry of Discovery: <i>S. H. Slichter</i>	1610
	The part of research that is pursued for profit contributes to the growth and stability of the economy.	
News of Science	Young Research Workers Sought for Washington Area Laboratories; other events ..	1614
Book Reviews	R. Jungk's <i>Brighter than a Thousand Suns</i> , reviewed by <i>E. U. Condon</i> ; other reviews	1619
Reports	X-ray Visualization and Analysis of Multicomponent Subjects: <i>R. S. Mackay</i>	1622
	Geochemical Scavenging of Strontium: <i>C. Frondel</i>	1623
	Rate of Swelling of Collagen: <i>H. R. Elden</i>	1624
	Measurement of Precipitin Reactions in the Millimicrogram Protein-Nitrogen Range: <i>D. Glick et al.</i>	1625
	Hypothalamic Lesions and Sexual Behavior in the Female Rat: <i>T. Law and W. Meagher</i>	1626
Departments	Chicago Academy of Sciences; Forthcoming Events; Equipment	1628

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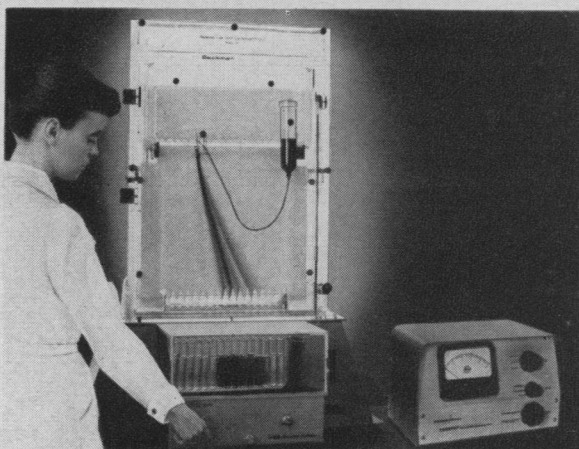
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ARE YOU OVERLOOKING SOME OF THE MOST CRITICAL CHALLENGES IN THE MATERIALS FIELD?

Listen in on this interview with Dr. A. E. Focke, Manager Materials Development at General Electric's Aircraft Nuclear Propulsion Dept., Cincinnati, Ohio

Q. Dr. Focke, I have heard it said that the Aircraft Nuclear Propulsion Program adds a new dimension to materials technology. Do you agree?

A. Strictly speaking, Mr. Walsh, reactor development for any application may be said to do this, since materials must be selected for their nuclear as well as their physical properties.

For some applications we look for high neutron absorption cross sections; for others, low capture cross sections.

For example, the material selected for the *moderator* must be capable of slowing down the neutrons produced by fission to thermal energy, about 1/40 ev from their original energy of several million ev with a minimum loss of neutrons by parasitic capture. *Control rods* on the other hand, must have high capture cross section for neutrons.

In practically all material applications for the nuclear power plant for aircraft which we are developing here, however, we have a high temperature problem of dimensions unique in materials technology.

Q. Why is that, Dr. Focke? Aren't these problems similar to those already solved for marine nuclear propulsion?

A. In the ANP program weight and size are severely limiting factors. Here we are dealing with a small, high density reactor a small fraction of the size and weight of the submarine reactor. To jam high energy into small volume requires the development of high temperatures. Generally the higher the reactor exit-air temperature, the better the overall performance of the power plant.

The crux of the problem here is the fact that common materials desired for some parts of the reactor for nuclear considerations, cannot operate at the maximum temperature of the over-all system.

These charts, prepared for a recent paper will give you a better conception of the materials problem. Fig. 1 summarizes the general requirements. Figs. 2, 3 and 4 review a few of the basic physical properties of each of 11 metals selected for discussion.

Q. Can a materials man work effectively at ANP without previous training in nucleonics?

A. Certainly. All the orthodox skills of the metallurgist, ceramist or chemical engineer are called into play here. The Aircraft Nuclear Propulsion Department will provide necessary training and information in nucleonics.

Q. What you've just told me, Dr. Focke, I certainly can discern the challenge to the materials man that you have here. I suppose you are working with alloys of some of the more exotic metals so much discussed in the latest technical literature?

A. Security limitations forbid my naming specific materials on which we are concentrating our investigations at this time. We have, however, made considerable progress, though a great deal of work remains to be done before our first high performance nuclear power aircraft makes its maiden flight.

One of our principal problems is to be sure we have people with the required technical competence and specific abilities to function effectively.

Component	High Strength At High Temp.	Ability to Resist Oxidation	Neutron Absorption Cross Section	Density	Special Requirements
Fuel Elements	x	x	Low	--	Compatibility with fuel.
Moderator	x	x	Low	Low	Ability to slow neutrons to thermal effectively.
Control	x	x	High	--	
Shield					
a. Gamma	x	x	--	High ⁽¹⁾	(1) Ability to attenuate γ .
b. Neutron	x	x	High ⁽²⁾	Low	(2) Ability to absorb without producing γ .

FIG. 1

Some characteristics of 11 metals in relation to possible application in Nuclear Power Plant for Aircraft—prepared by Dr. A. E. Focke, Manager, Materials Development.

Thermal Neutron Absorption Cross Section In Barns	
1. Hf 105.0	
2. Re 84.0	
3. Ta 21.3	
4. W 19.2	
5. U 7.68	
6. Th 7.4	
7. Ti 5.6	
8. V 5.1	
9. Mo 2.5	
10. Cb 1.1	
11. Zr 0.18	

FIG. 2

Melting Point-°F	
1. W 6116	
2. Re 5756	
3. Ta 5426	
4. Mo 4752	
5. Cb 4474	
6. Hf 4032	
7. V 3452	
8. Zr 3375	
9. Th 3308	
10. Ti 3020	
11. U 2071	

FIG. 3

Crystal Structure	Allotropic Transformation
1. Re h.c.p.	NONE (known)
2. Hf h.c.p.	b.c.c. 3020°F
3. Ta h.c.p.	b.c.c. 1620°F
4. Zr h.c.p.	b.c.c. 1584°F
5. Th f.c.c.	b.c.c. 2426°F
6. W b.c.c.	NONE
7. Ta b.c.c.	NONE (known)
8. Mo b.c.c.	NONE
9. Cb b.c.c.	NONE
10. V b.c.c.	NONE
11. U ortho	tetra 1220°F; b.c.c. 1427°F

FIG. 4

Metallurgists, ceramists, physical chemists, solid state physicists with background in hi-temperature materials are invited to inquire about professional opportunities in these areas. Nuclear experience, while desirable, is not essential.

Write in confidence including salary requirements to: Mr. P. W. Christos, Professional & Technical Personnel—Division 63-WP

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A FEW OPENINGS IN OTHER AREAS OF THE PROGRAM FOR: NUCLEAR ENGINEERS • THERMODYNAMICISTS • MATHEMATICIANS

Meetings

Chicago Academy of Sciences

It is significant of the rapid growth of our country that the Chicago Academy of Sciences, at the time of its founding in 1857, should have been known as "the first museum of the West." It is strange, indeed, to reflect that only 100 years ago Chicago was a sprawling pioneer community and that the academy was the first scholarly institution on the scene. Washington's Smithsonian had been

founded only 11 years earlier, and through the years a traditional bond has existed between the two. Robert Kennicott, first director of the academy, was a young protégé of Spencer Fullerton Baird, assistant secretary of the Smithsonian in those days. It was the young Kennicott whose scientific reports on Russian Alaska, as leader of the Overland Telegraph Expedition, made the United States aware of the value of this vast territory. When the project to link Europe to North America via Bering Strait was terminated by the successful laying of the Atlantic cable, the scien-

tific results of the Kennicott expeditions were the only tangible results of the giant undertaking. But they influenced our Government to purchase Alaska.

Early sites of the academy were twice destroyed by fire, the last time by the great Chicago fire of 1871. The present building in Lincoln Park was built in 1893 at a cost of \$100,000, through the generosity of Matthew Laffin, who contributed \$75,000, and the commissioners of Lincoln Park, who contributed \$25,000. The academy has received major bequests from several others—\$100,000 from W. Moses Wilner, \$140,225 from Melissa Dickinson, \$150,000 from Albert Dickinson, and \$26,843 from Elsie S. Sandquist.

Founded for the "increase and diffusion of scientific knowledge," the academy has steadfastly pursued this goal. But science has its vogues, even as the world of fashion. In 1857 science was acquisitive. It was a time for discovery and classification of animals and plants, and in the early academy *Transactions* such work was published and broadcast to the scientific world. So, too, in its present *Bulletin*, *Special Publications*, and *Natural History Miscellanea*, the academy has ranged the whole wide field of science to continue the "increase and diffusion" of such knowledge. In an old institution like this you may read history off the library shelves or herbarium sheets. Here is a copy of Dana's *System of Mineralogy*, published in 1868; here a collection of plants made west of the 100th meridian by Palmer and Wolf in 1868.

Now the vogue is changing. The need for taxonomy is still as acute as ever in entomology and invertebrate classification but less urgent for higher vertebrates. There is time to investigate the biological interrelationships of animals and plants in studies of ecology and parasitology. Joseph Camin, staff acarologist, has a three-year grant from the National Institutes of Health to study mite-borne diseases and the genetics of the ability of mites to transmit blood diseases of vertebrates. The academy director concerns himself with bird physiology and the influence of the ice age on bird speciation and present migration routes.

But the academy feels most strongly its responsibility to diffuse knowledge to the public. At a time when science education is actually unpopular in the schools and scientists are regarded variously as unfeeling ascetics and dangerous crackpots, our role should be to correct misconceptions. Obviously, students come by such ideas via their teachers, and the need for good science teachers is therefore as great as that for well-informed students. Badly needed, too, is a respect for scholarly accomplishment to replace the present passion for mediocrity among students and even professional men. To

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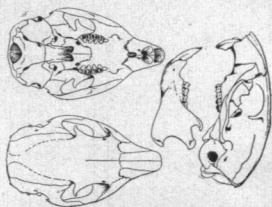
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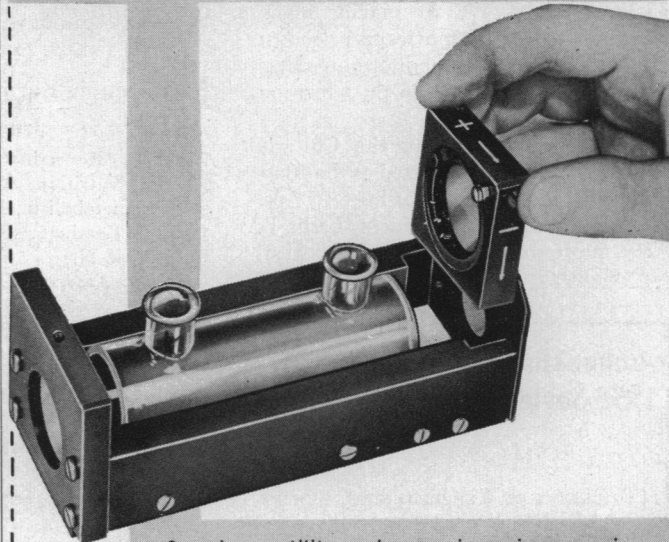


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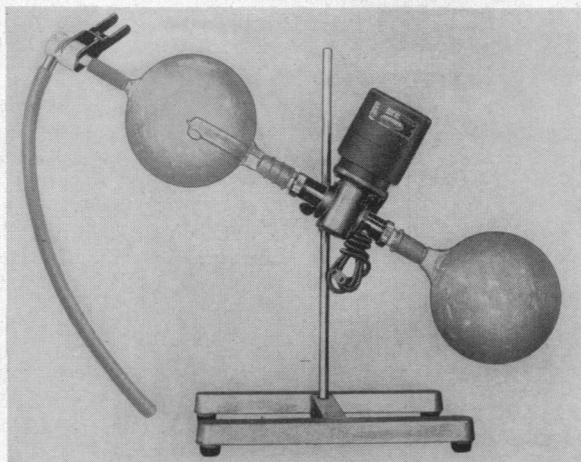
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