Hovel and Glaser point out that concentrating sunlight may considerably improve the outlook for reaching this goal.

The efficiencies of thin-film photovoltaic devices are still far below those achievable with single crystals; their present 5–8% level of efficiency is only on the ragged edge of usefulness. Cells of low efficiency require larger areas and therefore more costly structures. Studies of the tradeoffs between efficiency and the costs of producing, mounting and connecting the cells, done at Brown University, indicate that economical operation requires at least 10% efficiency.

Practical systems must take into consideration losses due to storage systems, such as batteries, to make energy available during nights and overcast days. For some small-scale applications—pumping of irrigation water, heat pumps for cooling, TV for developing countries—some of which do not require energy storage, photovoltaic power already looks promising. The use of solar cells for central power plants with steady base-load output is still remote, however. Large installations present practical problems such as shading of large areas, structures that must withstand high winds, snow, dust and hail, and suitable means of energy storage.

The field of photovoltaic conversion is in a creative ferment and, while it is too early to tell which system will win the horse race, a lot of interesting work is being done. —HRL


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## Dubna believes it has produced element 107

A group at the Joint Institute for Nuclear Research in Dubna, headed by Georgi Flerov, says it has synthesized element 107. If verified, the Dubna observation would be the highest-$Z$ manmade element. It is the latest in a long series of attempts to extend the periodic table, made sometimes at Lawrence Berkeley Laboratory, sometimes at Dubna, sometimes at both. (More recently a group at Oak Ridge has joined the competition.) One priority dispute, over the discovery of element 104, is being settled by having a Dubna experimenter observe the Berkeley experiment and a Berkeley experimenter observe the Dubna experiment. Two years ago Berkeley and Dubna both announced the discovery of element 106 (PHYSICS TODAY, November 1974, page 19). In the case of element 107, however, Berkeley is not claiming to have found 107, although Albert Ghiorso told us they would like to start looking for it this year.

**The new Dubna experiment,** reported[1] in *JETP Letters,* was done by Yu. Oganesyan, A. G. Demin, N. A. Danilov, M. P. Ivanov, A. S. Il'inov, N. N. Kolesnikov, B. M. Markov, V. M. Plotko, S. P. Tret'yakova and Flerov. The crucial thing in the experiment is cross bombardment, which leads to the observation of element 105. Using a 310-cm cyclotron, the experimenters obtained a beam of $Cr^{54}$ ions (with a charge state of +8) with energy 290 MeV. They bombarded a target of ${}_{83}Bi^{209}$ and at first found a spontaneously fissioning emitter with a halflife of 5 sec. They reasoned that such a halflife was too long for element 107 and that the activity was probably associated with element 105.

So they tried other bombardments, using different combinations of targets and projectiles that would add up to 105: ${}_{83}Bi^{209} + {}_{22}Ti^{50}$ and ${}_{82}Pb^{208} + {}_{23}V^{51}$, and observed a 5-sec activity, which they then attributed to element 105. Revamping their equipment to look for shorter halflives, they found one of about 2 msec. The results of experiments with the reactions $Bi^{209} + Cr^{54}$, $Pb^{208} + Mn^{55}$ and $Tl^{205} + Fe^{58}$ have indicated that the yield of this activity exhibits the regularities expected for element 107. They also say that the yield of this emitter correlated in all the experiments with the yield of the 5-sec activity. They interpret this result to mean they were seeing spontaneous fission of the isotope ${}_{105}X^{257}$, produced after the alpha decay of ${}_{107}X^{261}$. Furthermore, the Dubna group says that element 107 has a branching ratio for alpha decay of about 80% and a spontaneous-fission branching ratio of about 20%.

**Objections.** The Dubna experiment has been criticized by some experimenters because the alpha energy has not been measured. In addition, Ghiorso says that the Dubna claim about the branching ratio is "astounding considering that no alpha particles have been observed." He says that he and his collaborators hope to look for element 107 this year by using a $F^{19}$ beam from the 88-inch cyclotron. They would search for the reaction $Cf^{249}(F^{19},4n){}_{107}X^{264}$.

Recently a group of scientists published[2] a manifesto, presumably in response to past Berkeley–Dubna feuds and the more recent controversy over the existence of element 126 and others in mica (see page 17). The basic criterion for discovery of a new chemical element, they observe, should be the establishment of the atomic number. Ideally, chemical identification should be made. "If the new element is observed through its decay by high-energy alpha-particle emission or spontaneous fission, or both, the chemical identification can be confined to separation from all known elements with atomic number greater than lead." Unfortunately, they note, such chemical identification has not been feasible in reported discoveries of the last several manmade elements.

Another scheme, the manifesto says, is to identify characteristic x rays produced when the isotope of the new element decays. Still another is to prove a genetic decay relationship through an alpha-particle decay chain in which the resulting product has been previously established. This method, however, depends on measuring "the half life and precise, unique energies of the alpha particles of the new isotope."

The manifesto argues that detection of a spontaneous-fission activity and measurement of its halflife "cannot *per se* establish that an element with a new atomic number has been produced." Ghiorso points out that the work on element 107 does not appear to meet the criteria set forth. Flerov told us that his group "regards this manifesto with irony." —GBL


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## Superheavies in mica

*continued from page 17*

less convincing, the group had said.

The report was exciting for many reasons. Manmade elements had been known only as high as element 106, although now a Dubna group has reported evidence for element 107 (see this page). Although there have been indications of heavier elements in meteorites, the presence in naturally occurring mica of elements in the range $Z = 116$ to 126 suggests that these superheavies are primordial. This would have great consequences for thinking about astrophysical element formation. Furthermore, the observations suggested two islands of stability, a hitherto unexpected possibility.

**Cerium gamma ray.** In July a group at Florida State began a systematic effort to find all possible nuclear gamma rays that might be produced by 4.7–5.7-MeV protons but had not yet been catalogued. They bombarded all the stable naturally occurring elements with atomic number greater than eight, except the noble gases, using a proton beam of 5.7 MeV. X rays and gamma rays were measured in the range 10–100 keV. The experimenters,