Meteoritics 29, 434–436 (1994)

Award

Leonard Medal Citation for Robert M. Walker

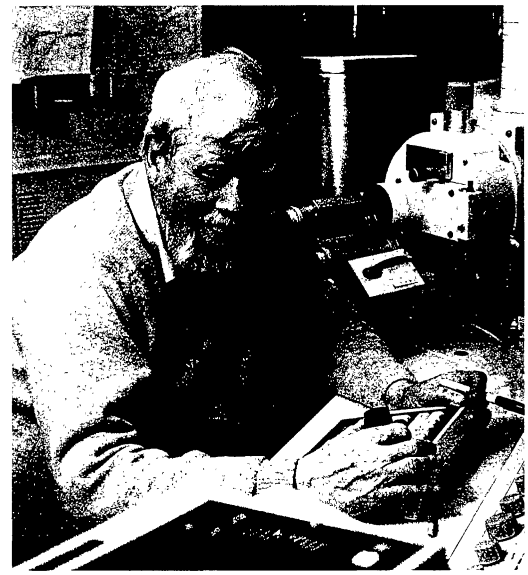
1993 July 22
Vail, Colorado, USA

The 1993 Leonard Medalist, Robert M. Walker, started his professional career during the 1950s, as a physicist studying radiation effects in solids. The work for which he is probably best known, the study of particle tracks in solids, began in the early 1960s at the General Electric Research Laboratories, in collaboration with R. L. Fleischer and P. B. Price. Many of us working in the field of meteoritics have had no formal training in geology. This is usually a handicap, but it proved to be important in launching the science of trackology. Muscovite mica was an important material in the early studies of particle tracks and, even today, is the optimum track detector in many respects. Consequently, one of the major motivating factors for Bob Walker in developing the techniques for detecting particle tracks in solids was the possibility of studying tracks in mica from meteorites and lunar rocks. Had he known more geology, he would have known that mica is not found in meteorites and was an unlikely phase for lunar rocks, and thus returned to the study of electron-induced defects in copper metal. The development of trackology was not all luck and hustle, however. A good knowledge of radiation effects in solids was important. Those of us with more superficial knowledge knew that producing an etchable trail of lattice dislocations should not occur with MeV/amu ions (corresponding to fission fragments) because we were taught that such ions interacted only with the electrons, not the nuclei, of lattice atoms. But Walker understood that in insulators, with low electron mobilities, the electrostatic wounds created by the passage of a highly ionizing particle might not have time to heal before the electrons could rush back in, and a permanent, although submicroscopic, trail of lattice dislocations would result.

Among the many consequences of the ability to see particle tracks in solids has been the development of the science of fission track dating, with a well-developed community of practitioners, who hold regular sessions at major geological meetings, have their own newsletter (appropriately named "On Track"), *etc.*

But, here it is appropriate to focus on the contributions of Bob Walker to meteoritics and the study of extraterrestrial materials in general. There are two major types of contributions that are worth separate discussion: personal and impersonal; that is, those to which the name R. M. Walker is attached and those to which it is not.

Taking up the personal contributions, it is interesting to note that the first paper on tracks in meteorites was not by Fleischer, Price, and Walker, but instead by Maurette, Pellas, and Walker (1964) based on work done during a period of residence by Walker in France in the early 1960s (ostensibly a trip to spread the gospel of trackology, but widely rumored as a trip to make sure that he didn't lose his fluency in French). I cannot do justice to the story of how Walker first showed a fission track to Pellas; this must be heard from either Walker or Pellas themselves. In any case, the paper by Maurette, Pellas, and Walker on the origin(s) of tracks in meteoritic olivine lists and evaluates seven possible origins for the tracks. Four alternatives are carefully discussed and ruled out. The possibility of tracks due to magnetic monopoles is summarily dismissed without discussion. (By his own admission, Walker has a



suspicion of, and aversion to, spectacular interpretations). Two alternatives were left: recoil tracks from spallation nuclear reactions induced by cosmic ray protons and secondary neutrons or tracks due to the slowing down of cosmic ray heavy ions (Fe-group nuclei). The pros and cons of these alternatives were given, with the preferred interpretation being spallation recoil tracks. (Presumably, if these authors had available the improved techniques for etching tracks in olivine, as developed later by Lal and co-workers, they would not have chosen the wrong alternative–a lesson about preferred interpretations).

Following Walker's return to GE, there followed a series of important Fleischer, Price, and Walker (FPW) papers on meteorites: (FPW 1965a, 1965b; FPW, Maurette, 1967; FPW, 1968).

The second major stage of Walker's personal research contributions corresponds to the Apollo era. Someone needs to document for posterity the contributions of Walker, along with Arnold, Gast, and Wasserburg, ("The Four Horsemen") to the initial handling of lunar samples and the establishment of the present Lunar Curatorial Facility, but this is not the place. Suffice it to say that the early 1970s were filled with the study of the rich particle track record in lunar rocks. Important milestones were (a) Crozaz, Walker and Woolum (1971), which made us all conscious of the major interplay between micrometeorite (as a source of erosion) and ion bombardment, and (b) Walker and Yuhas (1975), which established the track production rate for galactic cosmic ray heavy ions.

The third major stage in the Walker personal research career corresponds to the interstellar grain era and continues on until the present. Around 1978, papers with the word *track* in the title disappear from the Walker publication list. This corresponds approximately to the first reports by Brownlee of the recovery of stratospheric interplanetary dust particles (IDPs). Walker saw a new challenge in the possibility of recovering interstellar material from IDPs or at least in the opportunity to compare the properties of IDPs and the properties of interstellar material as inferred from astronomical observations. Initially, most of us were fascinated with IDPs but somewhat paralyzed because of the difficulty in obtaining IDP data in familiar forms, such as, thin section petrography, electron microprobe analyses, REE patterns, *etc.* Walker's response was to develop a whole new set of technologies to handle and study IDPs. A legitimate contribution was even an abstract by Fraundorf *et al.* (1982) on how to weigh an IDP. Some studies by Walker's laboratory have applied as many as 10 instruments to the study of a single IDP, and in general his work has contributed significantly to the establishment of IDP studies as part of meteoritics. The work of Lewis and Anders during the 1980s established carbonaceous chondrites as the major source of interstellar grains rather than IDPs, but the arsenal of capabilities developed at Washington University for IDP studies was ready for use on the interstellar material recovered from carbonaceous chondrites. Quite typically, Walker has selected one of the more difficult studies for himself, as reported at the 1993 meeting of the Meteoritical Society: the important problem of determining the petrographic contexts of interstellar silicon carbide.

Turning to the impersonal contributions of Walker to meteoritics, these can be documented by simply noting that at the 1967 meeting of the Meteoritical Society, there were no contributions from Washington University. At the 1993 Meeting, there were 15 abstracts involving Washington U. staff and 7 others by the Bob Walker Washington U "alumni" (persons who were students or postdocs with Walker). To give perhaps the best-known specific example, the IDP instrument arsenal discussed above has played a major role in documenting and characterizing interstellar grains (*e.g.*, the TEM identification of silicon carbide by Bernatowicz and the ion microprobe studies by Zinner). Although only a few of the papers bear his name, these and the other significant contributions to meteoritics and to planetary science in general can be traced back to Bob Walker's arrival in St. Louis in 1968. More subjective, but equally important, is the sense of the fun and excitement of science that even the casual visitor notices about the 4th floor of Compton Laboratory.

Finally, it is important to mention contributions to society at large. Many of us have decided that the fate of the world is beyond our control. But this has been just another challenge to Bob Walker. In 1960, he co-founded the private group, Volunteers in Technical Assistance, to organize and coordinate private technical assistance for developing nations. He remains an advisor to VITA to this day.

In closing, it is my great pleasure to present the 1993 Leonard Medal citation for Robert M. Walker, an outstanding scientist and a good human being.

Don Burnett
Division of Geological and Planetary Sciences
California Institute of Technology
Pasadena, California 91125, USA

REFERENCES

CROZAZ G., WALKER R. AND WOOLUM D. (1971) Nuclear track studies of dynamic surface processes on the moon and the constancy of solar activity. *Proc. Apollo 12 Lunar Sci. Conf.*, 2543–2558.

FRAUNDORF P., HINTZ C., LOWRY O., MCKEEGAN K. AND SANDFORD S. A. (1982) Determination of the mass, surface density, and volume density of individual interplanetary dust particles (abstract). *Lunar Planet. Sci.* **13,** 225–226.

FLEISCHER R. L., PRICE P. B. AND WALKER R. M. (1965a) Tracks of charged particles in solids. *Science* **149,** 383–393.

FLEISCHER R. L., PRICE P. B. AND WALKER R. M. (1965b) Spontaneous fission tracks from extinct Pu^{244} in meteorites and the early history of the solar system. *J. Geophys. Res.* **70,** 2703–2707.

FLEISCHER R. L., PRICE P. B., WALKER R. M. AND MAURETTE M. (1967) Origins of fossil charged particle tracks in meteorites. *J. Geophys. Res.* **72,** 331–352.

FLEISCHER R. L., PRICE P. B. AND WALKER R. M. (1968) Identification of Pu^{244} fission tracks and the cooling of the parent body of the Toluca meteorite. *Geochim., Cosmochim, Acta* **32,** 21–31.

MAURETTE M., PELLAS P. AND WALKER R. M. (1964) Cosmic-ray-induced particle tracks in a meteorite. *Nature* **204,** 821–823.

WALKER R. AND YUHAS D. (1973) Cosmic ray track production rates in lunar materials. *Proc. Lunar Planet. Sci. Conf.* **4th,** 2379–2389.

Acceptance Speech

ROBERT M. WALKER

McDonnell Center for the Space Sciences
Washington University,
St. Louis, Missouri 63130, USA

It is a great pleasure for me to accept the Leonard Medal of the Meteoritical Society—partly because the study of extraterrestrial samples has taken up a large part of my professional life but also because meteorites played an important role in stimulating my interest in science. Growing up in New York City, I often visited the Hayden Planetarium with its magnificent specimens of the Cape York iron meteorite. I still remember the awe that I felt when touching the convoluted, ablated surfaces of these marvelous objects.

Now I wish I could say that I immediately perceived all the wonderful things that could be learned from studying meteorites. But that would not be entirely true. As late as 1954, in my last year as a graduate student at Yale completing a thesis in high energy physics, I remember being quite turned off by a set of lectures on the Moon given by Harold Urey. At the time, it seemed to me that we would never be able to test any of the ideas that he was discussing; issues like chronology and composition would always remain in the realm of speculation not fact and, thus, were not the kind of problems that would interest me.

I was, however, not totally without imagination nor, indeed, prescience. Although I blush to admit it—but, believe me, I was very young—I still remember promising ,"the Sun, the Moon, and the stars" to an engaging companion one evening. My recollection is that she was not impressed; to my subsequent astonishment, it turned out that I could have delivered on the promise. The Moon samples were extensively studied by us, the depth dependence of tracks in lunar rocks measure solar flare particles, and, of course, the wildly isotopically anomalous grains in meteorites give witness to their origins around other stars.

I have certainly had a lot of fun in the process! As detailed in the warm citation by Don Burnett, my personal interest in meteorites has focused more on what we could learn from them