be constructed to detect and identify individual charged particles at ultrarelativistic energies.

A specially designed photomultiplier tube incorporating the new material as the secondary-emission cathode is being constructed for detailed studies of possible single particle detection.

Conclusions

It appears possible to extend the application of most of the existing detection techniques to the identification and separation of charged particles in the relativistic energy region. One can probably extend these applications, in certain limited cases, up to an energy region of several hundred billion electron volts. However, for general applications in the identification of particles in the ultrarelativistic region, the existing detectors are rather limited, and new methods and approaches are desirable. At present, detectors making use of the relativistic rise effect seem to show considerable promise.

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NEWS AND COMMENT

The Smale Case: NSF and Berkeley Pass Through a Case of Jitters

To savor the pungency of the events about to be related, it is necessary to be mindful of the bruised condition of the two institutions that are central to the story. First there is the National Science Foundation, which has an instinct for trouble-avoidance derived from 15 years of congressional badgering, budget slashing, and allegations that NSF's clients have been living it up or pursuing esoteric nonsense at the taxpayers' expense. Then there is the academic world's leading convalescent, the Berkeley campus of the University of California, where the fragile peace that ended nearly 2 years of debilitating strife is now being sniped at from the right by Ronald Reagan, the Republican candidate for governor. If administrators at NSF and Berkeley are edgy and cautious, who can blame them?

With this backdrop in place, it is time to introduce the central figure of the story, Stephen Smale, age 36, of the mathematical species known as differential topologist, and of the political species known as left-wing activist. Seven years ago Smale achieved an enduring place in topology by developing a theory for turning a sphere inside out without creasing it, let alone cutting it. But the matters that we are concerned with here relate to Smale's recent role in turning Berkeley and NSF inside out, the former being the place where he holds a tenured professorship in mathematics, and the latter being the source of a $91,500 grant, which, as principal investigator, he shares with some 15 other mathematicians. Let us go back a bit and trace the complex train of events in the Smale affair.

Despite his courteous mien, soft speech, and scholarly dedication, Stephen Smale long ago became practiced in speaking out or acting on his convictions when he doesn't like what's going on around him. In high school he agitated against a ban on teaching evolution. As an undergraduate at the University of Michigan, he was put on probation for refusing to cooperate in an investigation of a private dinner that was held for a speaker who had been barred from the campus. But along the way he was also, as the expression goes, "doing mathematics" and mathematics of a most distinguished sort. In 1961, an appointment to Columbia is said to have made him the youngest full professor on any major campus in the country.

In 1964, Berkeley, the mecca of mathematics and academic political activism, beckoned, and Smale went west. He naturally was involved in the Free Speech Movement, and later went on to co-found the Vietnam Day Committee, whose climactic act, last October, was intended to be a demonstration aimed at stopping troop trains. But, as Smale said in an interview with *Science,* he was deeply disappointed when the marchers did not attempt to cross the police cordons. "After all the buildup, the tactic of turning away left people feeling demoralized," he explained. Motivated in part by disappointment over what he considered to be a lack of militancy among his Vietnam Day Committee associates, Smale pretty much dropped out of the movement, and nothing was thereafter publicly heard of him until this past summer. Then began a complex series of events that was to make Smale probably the best known topologist of all time.

At the end of the last academic year, Smale, as is not uncommon in the academic community, embarked on an extensive work and vacation trip, the culmination of which, in his case, was to be the International Congress of Mathematicians, in Moscow, starting 16 August. There he was to deliver a paper and receive the Fields award,

which is considered the Nobel prize of mathematics. During two of the months of his absence from Berkeley he was to be on a so-called summer salary, which Berkeley was to pay him from funds included in the NSF grant. Prior to his departure Smale drew $1000 which was specifically earmarked, in the $91,500 grant, to go toward his expenses in traveling to and from and attending the Moscow conference. He also applied for, and received, another $400 of NSF funds that were administered by the National Academy of Sciences–National Research Council to help meet the expenses of mathematicians attending the conference. And off he went to Europe at the end of May.

The next public notice of Smale came on 5 August, when the San Francisco *Examiner* wrote of him that, "in leaving the country, he has dodged a subpoena directing him to appear before the House Committee on Un-American Activities in Washington." The next day, the *Examiner* ate crow in the form of a correction headed, "Moscow-Bound UC Prof Not Avoiding Subpoena." Smale, it turned out, had been long gone when the subpoena, which was inspired by his political activities at Berkeley, was issued, and he knew nothing of it (*Science*, 2 September 1966). Furthermore, HUAC had apparently violated its own regulations against publicly announcing subpoenas prior to delivery.

In any case, while he was in Europe his interest in political activism underwent renewal. At the University of Paris, the first stop in his European travels, he learned that a French mathematician and several Japanese colleagues were drafting a bitterly worded declaration against American involvement in Vietnam, with the intention of presenting the declaration at the Moscow meeting of mathematicians. Smale says he played a minor part in drafting the resolution. It was not until after that meeting began, however, that anything was publicly heard of him again. On 21 August the New York *Times* reported decisive sentiment at the Congress of Mathematicians against associating the meeting with any political statements; thus the Paris declaration went no place. But, at the same time, the *Times* reported preparation of a resolution which denounced HUAC for creating the impression that Smale had skipped the country to avoid the subpoena. That resolution was also submerged by reluctance to involve a scientific meeting in political affairs, but Smale granted an interview in which he attacked HUAC for having released his name. At that point twitters of concern began to be audible in Washington. On 24 August a memorandum went out from the Academy's section on the U.S.S.R. and Eastern Europe, entitled "Political Activity at Moscow Congress" and addressed to this country's "Official Delegates and Alternates" to the Moscow congress. Attached was a copy of the *Times* story. Said the memo:

> Officials of the Department of State have asked the Academy for information about the activities reported in this article. Presumably, the Department has also asked the American Embassy in Moscow to report on this subject. In any event, we would appreciate any comments you may be able to make to us about political subjects raised in the context of the congress which we in turn could pass on to the Department of State.

That was not all that was to be heard from or about topologist Smale, though what happened next is a matter of some confusion. By Smale's account, "In the middle of the conference, I and two others were invited to dinner by some North Vietnamese mathematicians. They asked me to give an interview to the North Vietnamese press. I was hesitant because I was afraid of the use they might make of it. So, I insisted that the American press be present. Both American and Russian newspapermen were then invited." But the night before the interview, he continued, the North Vietnamese newsmen, without offering an explanation, informed him that, instead of attending the conference, they would submit written questions.

The result of these arrangements was that at 10 a.m. on 26 August Smale stood on the steps of Moscow University and read a statement that opened with words that were undoubtedly pleasing to the Russians and the North Vietnamese. But Smale's penchant for broadcasting his dissent was not limited to the activities of the West. Said Smale:

> I believe the American military intervention in Vietnam is horrible and becomes more horrible every day. . . . However, in Moscow today, one cannot help but remember that it was only 10 years ago that Russian troops were brutally intervening in Hungary and that many courageous Hungarians died fighting for their independence. Never could I see the justification for military intervention, 10 years ago in Hungary or now in the much more dangerous and brutal American intervention in Vietnam.
>
> There is a real danger of a new McCarthyism in America. . . . Again saying this in the Soviet Union, I feel I must add that what I have seen here in the discontent of the intellectuals on the Sinyavsky-Daniel trial and their lack of means of expressing this discontent, shows indeed a sad state of affairs. Even the most basic means of protest is lacking here. In all countries, it is important to defend and expand the freedoms of speech and the press.

The events that followed produced conflicting accounts. The *Times* reported that Smale was "taken for a fast and unscheduled automobile ride through the streets of Moscow, questioned and then released . . . after he had criticized both the Soviet Union and the United States at an informal news conference."

Smale's account, which dovetails in large part with versions offered by his colleagues who were present, is quite different.

In the middle of the interview, he said, a woman broke in to say that V. G. Karmanov, Secretary General of the organizing committee of the Congress, wished to see him. Smale said he replied that he would go immediately after completing the conference. At the conclusion, a Russian woman reporter said she had several more questions. Smale said he replied that he would see Karmanov and then speak to her. In the Secretary General's office, he said, Karmanov made no reference whatsoever to the news conference. "He asked me about Soviet math, congratulated me on getting the prize, and gave me a present, a picture book of the Kremlin with German text. Then he offered me a car to go sightseeing in Moscow."

Smale said he had no desire to go sightseeing, but upon coming out of Karmanov's office, seeing a crowd there which included several American reporters, and being reminded by the Soviet reporter that he had agreed to answer more questions, "I figured we could get into the car and drive off and talk." The Americans, he said, were pushed aside by several Russians. "I shouted at them," he said, "that Karmanov and I had not discussed the news conference," and off he went. (Smale was quoted in the *Times* as saying, "It seemed to be a rather rude attempt to keep me from talking with Western correspondents." But he told *Science* that the remark should not be interpreted to mean that he felt he was being silenced. "I think maybe the Russians thought they were trying to protect me from the American reporters," he explained.)

Smale said that, after they had driv-

World Wide Photo

SMALE IN MOSCOW: This photo was transmitted with a caption that described Smale (center) as being "escorted by two big Russians after his press conference was interrupted in Moscow today. The conference was halted after Smale said Soviet intellectuals are discontented." Smale, however, says the conference was not halted, and that the man on the left is V. G. Karmanov, a Russian professor with whom he had an amiable chat at the conclusion of his press conference. Smale said he does not know the man on the right.

en away from the university, the Russian reporter said she was primarily interested in making a copy of his press conference statement. Smale said he didn't want to go sightseeing, so they went to her office building and copied the statement, and he was promptly returned to the university.

If there had been nervousness before about the carryings-on of this grantee of the U.S. Government, there was gross agitation when Representative Richard L. Roudebush (R–Ind.) began to probe into the affair. Roudebush, who sits on the Science and Astronautics Committee, which has legislative authority over NSF, demanded from the Foundation a financial accounting of its relations with Smale. On 12 September he issued a press release headed: "Congressman Roudebush's Inquiry Reveals Professor Traveled to Moscow for U.S. Denunciation at American Taxpayer Expense."

The text of the press release stated:

> A University of California professor who called a press conference in Russia last month to denounce American policy in Vietnam drew $2778 per month this summer and $1000 round trip jet fare from Berkeley to Moscow under terms of a federal grant. . . . Congressman Roudebush has requested a complete report from the National Science Foundation. . . . and the NSF reported they had asked the University of California authorities for a complete report on his activities the past summer.

Thus NSF and Berkeley—two institutions with no stomach whatsoever for such trouble—were on the spot to account for the affairs of Stephen Smale. What NSF said to Berkeley is not clear, since it appears that many people at NSF were simultaneously saying a great deal to many people at Berkeley. But it appears that a dominant note in NSF's communications was that, unless Berkeley could vouch for Smale's having spent 2 summer months on research, NSF would not credit that time toward summer salary paid out of NSF funds. Or, as NSF director Leland J. Haworth told *Science*, "We raised questions with Berkeley about whether we would reimburse for summer salary."

At this point, then, it became essential to locate Smale, which proved to be no easy task. Upon leaving Moscow, on 27 August, he flew to Greece, met his wife and two children, who had waited for him there during his stay in Moscow, and drove to Istanbul. Then they drove to Paris, and on 9 September boarded the S.S. *France* for New York. Meanwhile, with the inquiries from NSF open to various interpretations, Berkeley decided to withhold Smale's August paycheck, pending an accounting of his summer months. At Berkeley, at the same time, the administration was making certain that no loose ends existed in the accounting for government-subsidized summer salaries —an exercise that often sends academics off into rhetorical rages about the impossibility of tying research to the time clock. (As Leon Henkin, acting chairman of the Berkeley math department, put it in a memo to Robert E. Connick, vice chancellor for academic affairs: "Objections are based on the nature of mathematical research work, the duration and intensity of which simply cannot be measured by examining such overt behavior patterns as sitting at a desk, reading books, or writing. The heart of the work which is contracted for goes on in the mind of the mathematician, and it is a common experience that this work actually intrudes into periods when the individual can be observed walking, eating, and sometimes even sleeping or conversing about other matters.")

Meanwhile, Smale and family had arrived at the Institute for Advanced Study, at Princeton, where he is to be in residence for the rest of the year. Upon being informed of the agitation surrounding him, and the withholding of his check, Smale sent to Connick an account of his summer researches—an account which will probably be a classic document in the literature of science and government. He quickly established that he had satisfied the requirement of 2 months of research for 2 months of salary by stating that he was at the Univerity of Paris for one week in May, and at the University of Geneva for virtually all of June and July. In addition, he established that his travel costs, Berkeley to Moscow and return, plus expenses for 10 days in Moscow, were in excess of the $1400 travel funds he had drawn prior to departure. He then went on to state:

> I consider that I spent full-time this summer on mathematical activity and research, whether measured from time spent on mathematics or on results produced.
>
> For bookkeeping purposes for the two-month summer National Science Foundation support, one can select a two month subset when I was attending a conference and/or had an office, e.g. June 13–July 30, August 16–27, and September 14–23. However, during the remainder of this time I was also doing mathematics, e.g. in campgrounds, hotel rooms, or on a steamship. On the S.S. FRANCE, for example, I discussed problems with top mathematicians and worked on mathematics in the lounge of the boat. (My best-known work was done on the beaches of Rio de Janeiro, 1960!)
>
> I would like to repeat that I resent your stopping of my NSF support money for superficial technicalities. The reason goes back to my being issued a subpoena by the House Un-American Activities Committee and the subsequent congressional and newspaper attacks on me.

While the grounds for paying Smale were being verified, NSF had to turn its attention to another front. In a letter to Haworth on 12 September, Representative Durward G. Hall (R–Mo.) demanded that "steps should be under-

taken to insure that no further grants are made to individuals whose public statements and actions are clearly intended to give aid and comfort to the enemy." To which Haworth replied, in a letter dated 27 September, that, on the basis of a policy formulated in 1957, the Foundation does not give grants to Communists, officially certified subversives, or advocates of unconstitutional change of government. Concluded Haworth:

> I have discussed the facts involved in the Smale situation, insofar as they are now established, with the Executive Committee of the National Science Board, with particular reference to the above policy. After careful consideration, we reached the conclusion that the principles on which the policy is based remain valid, and that while this policy may, on rare occasions, permit support of the research of an individual who can be considered to have acted improperly, the policy provides a sound frame of reference for the support of unclassified research by the National Science Foundation. Under this policy, the known facts regarding Professor Smale provide no basis for termination of support to the University of California with respect to next year's summer salary to Professor Smale.

Hall responded by dispatching Haworth's reply to Secretary of State Dean Rusk, with the comment: "I cannot believe that the Department of State would take the same attitude on the grant as the National Science Foundation, and I would appreciate your comments on the matter." That is probably a reasonable speculation, but then Congress, in its wisdom, did not make the Department of State responsible for supporting basic research.

On 30 September Berkeley decided that Smale had properly accounted for his summer research activities and sent him his pay. And that is the end of the chapter, and possibly the end of the story.

However, persons associated with the uppermost policy level of NSF remain quite unhappy and even a bit sore about the whole business. They point out that Smale gets his money from NSF, but, to get that money, NSF officials have to go before a congressional committee that regularly slaps them around. As one of them put it, "It's getting tougher and tougher to get money for basic research, and we are probably going to have to pay a stiff price for defending Smale's right to sound off on Vietnam." He agreed, however, that it was a vitally important right, and ended up sounding quite tired about the whole affair.

—D. S. GREENBERG

Scientist-Astronauts: Only the "Perspicacious" Need Apply

The National Aeronautics and Space Administration, which had often been accused of failing to give proper emphasis to the scientific aspects of space exploration, 2 years ago began—as one answer to its critics—an effort to recruit scientist-astronauts. While this effort resulted in the appointment last year of six scientists for training as astronauts, it fell short of its goal. NASA had hoped to appoint as many as 20 such trainees. Now NASA is recruiting again, this time giving the National Academy of Sciences a larger role in order to take advantage of the long-established lines of communication between the Academy and the scientific community.

The Academy has agreed to spread the word about the scientist-astronaut program among university science departments, and to do all but the final screening of candidates. In the last recruitment campaign NASA sent announcements to the universities, but in many cases these notices seem to have received scant attention.

Results of the new recruiting effort are likely to be disappointing unless promising young scientists are convinced that the manned space flight program offers them opportunities for important scientific work. Conscious of this, the Academy's Space Science Board, which serves as NASA's scientific advisory body, has promised to keep an eye on the program and to help the scientist-astronauts continue their growth as scientists.

In simultaneous announcements on 26 September, NASA and NAS said that applications for the scientist-astronaut program will be received through 8 January 1967.* Successful candidates will be notified of their selection before 30 June and told to report to the Manned Spacecraft Center at Houston on 15 July. As many as 20 candidates may be accepted if that number survive the rigorous screening.

To quote an Academy brochure, the quality most needed by a scientist-astronaut is "perspicacity." He must, the brochure says, be able to quickly pick out, from among the thousands of things he sees, those that are significant, and to synthesize observations and develop and test working hypotheses.

Some 1400 persons applied to NASA after the first recruitment effort was announced in October 1964. NASA screened out about 1000 candidates, whose applications showed that they did not meet the minimal criteria. The applications of the remaining 400 candidates were submitted for further review to an *ad hoc* NAS panel. The panel, which is to screen candidates again next year, was (and is) chaired by Eugene M. Shoemaker, chief of the U.S. Geological Survey's astrogeology branch. Harry H. Hess, head of Princeton's geology department and chairman of the Space Science Board, was among its members. Only 16 of the candidates were recommended to NASA by the panel. Of these, NASA selected six (one later resigned) after the candidates had been given a physical examination and put through a space simulation program to test their ability to withstand the stresses of launch, space flight, and reentry.

The extremely low survival rate among the 1400 applicants was due to a variety of reasons. A high perspicacity quotient does not, of itself, assure one of being chosen as a scientist-astronaut. The minimal criteria for selection are difficult to meet. An applicant must have a doctorate in the natural sciences, medicine, or engineering, or be assured of completing all requirements for a degree by 15 July 1967, or, if he lacks

* For further information, prospective applicants should write to Scientist as Astronaut, National Academy of Sciences–National Research Council, 2101 Constitution Avenue, NW, Washington, D.C.