Letters

The Littlest Astronomer (continued)

On another mountain lived three other astronomers. The biggest astronomer was very smart; he knew more than just about anybody about telescopes and the stars. He had built the Great Telescope on the mountain and it was famous all over the world. He liked to build telescopes, but best of all he liked to explore the sky with them and see a thing a little better than it had ever been seen before. He couldn't do this much any more. He knew that there were not enough telescopes for all the good astronomers, and that we would learn more about the sky, in the long run, if he spent his time getting more telescopes instead of just using the Great Telescope. Getting more telescopes was hard work, and he had to spend much time far away, where the keepers of the money lived.

The middle-sized astronomer was also smart. He was an expert on making telescopes work, and on making special calculations, and particularly on what was an important thing to work on. He liked best to explore the sky with the Great Telescope, and to understand something a little better than it had ever been understood before. He couldn't do this much any more. All day the littler astronomers came to his office and asked him to give advice about their projects, to fix their mistakes, and to adjust the telescope a little better for them so they would do better the next night. He always helped them, and all the astronomers discovered more as a result. The astronomer was glad. When the biggest astronomer was gone, as he often was, the middle-sized astronomer had to do all the biggest astronomer's work, too. Sometimes he had to say something about astronomy on television. He didn't like this, because it was embarrassing, but he knew that if he didn't say it the television people might have a bad astronomer say things that were wrong, and then all the astronomers would be embarrassed and unhappy. It was hard work, but there was no one else who could do it.

The littlest astronomer was smart, but he had never tried to be an expert at anything. Nobody came to him for advice, because he didn't know any more than anyone else. He was glad no one bothered him. Best of all he liked to explore the sky with the Great Telescope, and that's all he did. He published lots of papers.

One afternoon the keeper of the Great Telescope came to the three astronomers and said, "The middle-sized astronomer has adjusted the telescope carefully and it will be a beautiful night tonight. Who would like to use the telescope?"

"I can't," said the biggest astronomer. "I was up all last night coming from the city where the keepers of the money live, and I am very tired. It was very uncomfortable, because I bought the cheapest ticket to save money. This evening I must find a way to build another Great Telescope that is better than ours, but which costs a little less. Our Board of Trustees needs the answer day-after-tomorrow. It will be hard, but I think I can do it. And I would like to play with my little boy just a little—I have not seen my family for a week."

"I can't," said the middle-sized astronomer. "This evening I must go to a college where there are no astronomers and tell the science students how exciting astronomy is." He had asked the littlest astronomer if he could give the lecture, but the littlest astronomer had said he had too many observations to study, and besides, he gave so few lectures that he wasn't very good at it.

"I can," said the littlest astronomer. And he did.

Later that night, as the littlest astronomer finally went to bed, the biggest astronomer was still awake, looking at the dark ceiling of his bedroom and worrying.

"Have I found the best and cheapest way to build a Greater Telescope? Will it best explore the most important problems I know of?" He tossed and turned, knowing he must be right so that all the astronomers could learn more about the sky.

The middle-sized astronomer was still awake, too. He had driven through a bad snowstorm until very late, because the students had kept him so long asking questions. Some had decided they wanted to be astronomers, too, and he was glad. But tomorrow he would have to make a very careful calibration of the Great Telescope so that the littlest astronomer could analyze his observations. He tossed and turned, trying to decide the best way to make the calibration. It had to be right if all the astronomers were to get the right answers. No one but the little astronomers would ever know who had arranged for them to get these right answers.

The littlest astronomer was sound asleep, and very happy. No one had bothered him all day. He could use the Great Telescope almost any time he wanted. He did just as he pleased, all day, every day. It was a good life.

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History of Carbon-14

I wish to record my wholehearted agreement with both the facts and the sentiments contained in Pollard's letter [*Science* **140**, 1268 (1963)] about the history of C^{14}. It is most regrettable that his very remarkable contribution to this subject was not mentioned in my article [*Science* **140**, 584 (1963)]. I am most grateful to him for his action in making possible a more complete record and, in addition, for emphasizing the main point of my article, which was that the discovery of C^{14} in the *physical* sense had been made by 1936 (and confirmed as late as 1939) but that its discovery in the *chemical* sense still remained in 1939 in the category of unpredictable events.

Pollard's report, published at the end of 1939, came to my attention shortly after Ruben and I had completed our identification of the C^{14} produced by the $C^{13}(d,p)C^{14}$ reaction in February of 1940. It presented evidence for the existence of the protons expected from this reaction, and thus extended and further verified the conclusions reached by Burcham and Goldhaber, and by Bonner and Brubaker, in 1936 to the

effect that C^{14} existed as an unstable isotope. Pollard's was a most remarkable effort in view of the state of cyclotron art at the time. He was able to assign an upper limit of ~ 300 kv for the expected C^{14} beta radiations. His value for the cross section of the $C^{13}(d,p)$ process relative to that for the $C^{12}(d,p)C^{13}$ reaction also was helpful in some of the early calculations I made on the C^{14} half-life. In the initial reports by Ruben and myself [*Phys. Rev.* **57**, 549 (1940); *ibid.* **59**, 349 (1941)] we cited Pollard's work.

My account of the early history of C^{14} was intended primarily to evoke the atmosphere in the Radiation Laboratory just prior to the chemical discovery of C^{14}. Pollard's experiences did not affect this aspect of the history, but they certainly were a significant contribution to the whole early history of C^{14}. I hope that this correspondence will assure their inclusion when the complete story is recorded.

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Congressional Image of NIH

The "News and comment" section [*Science* **140**, 1076, 1194 (7 and 14 June)] has effectively described certain aspects of the relationship between Congress and the National Institutes of Health and has made it quite clear that members of Congress are unfamiliar with, and uninformed about, many of the serious problems encountered in the pursuit and administration of NIH-sponsored research. Improvement in this relationship would improve the congressional image of NIH.

It has been suggested that NIH assume the initiative and undertake an additional educational effort, namely, that of telling "their political leaders how [recipients of federal funds] are using the public's money," through the encouragement of visits and communication between Capitol Hill and the facilities and staff of the Institutes in Bethesda. Providing it does not become an all-consuming activity and a distraction from the basic functions of the NIH, this kind of program should be pursued.

On a different level, more than 80 percent of the NIH appropriation is expended in extramural grants, and grantees are to be found throughout the country. Although the membership of the House Intergovernmental Relations Subcommittee is limited and is drawn from only a few locales, every grantee is represented in Congress by two senators and one member of the House. Grantees themselves can easily take some share of the initiative towards improving the congressional understanding of scientific research by inviting and encouraging their representatives to visit laboratories within their own constituency. This should not involve any additional direct financial burden. Congressmen may be formally invited to schedule such visits at their convenience—on such occasions as they might return to their districts or state for other purposes, for instance, between congressional sessions.

With this in mind, we have invited the senators and representatives from our jurisdiction to visit us, hoping that they will gain a better understanding of the activities in which we are engaged. We hope also to convey some appreciation of the unique problems involved in the formulation, execution, and interpretation of scientific inquiry. These visits will not be conducted as "state occasions," with elaborate programs and speeches, but rather as serious attempts to impart information. We expect, during these visits, to keep local administrative details and intervention at a minimum.

This kind of "grass roots" approach to the problem of inadequate liaison between congressmen and the scientists for whom they appropriate funds can benefit both parties. It requires a modest expenditure of time and energy, but the reward will surely justify the investment.

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Three Princes of Serendip

It is interesting to note that your editorial [*Science* **140**, 1177 (14 June 1963)] puts a meaning on serendipity which is quite close to the structure of its original source, the story of *The Three Princes of Serendip.* This story describes brilliant deductions from apparently unrelated observations, much in the manner of modern detective stories, and the term serendipity as now used is an excellent example of distortion by dependence on secondary and tertiary sources.

The Three Princes of Serendip seems never to have been translated into English, the only easily accessible version being a German translation of the Italian translation of the Persian, which appeared in the journal *Folklore Fellows* about 20 years ago. It was brought to the attention of English-speaking people by a brief and oblique reference in one of Horace Walpole's letters, in which he said that he had heard about it from a friend, but not whether he had read it himself. When the origin of serendipity is mentioned by modern research writers, they sometimes mention Walpole also, but I have never seen such a reference which was made specific by direct quotation or even the date of the letter in question. Hence one may doubt that more than a small fraction of persons who speak and write of serendipity have read Walpole's comment, which is itself only a secondary reference, or worse.

I believe that the literary background of science would benefit by the publication of *The Three Princes* in English. Surely there must be some publisher who would think it worthwhile to translate two hundred pages of German for this purpose.

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In spite of your contention that "the research worker gets no more from his experiments than he puts in . . .," there is a wide and inexplicable area of inspiration. The few times that I was allowed to experience this sudden flash of insight are among the highlights in my life.

I also object to the last sentence in your editorial: "Serendipity is a bonus to the perceptive, prepared scientist, not a substitute for hard work." Serendipity is much more than a bonus, it is a blessing. "Perceptive," yes, "prepared"—not necessarily. This mysterious spark cannot be trained or guided. One either is a prince of Serendip or one isn't.

"Mere thinking cannot give us a sense of the ultimate. I cannot conceive of a genuine scientist without that profound faith. Science without religion is lame, religion without science is blind" (Albert Einstein).

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