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Stereotypic Images of the Scientist: The Draw-A-Scientist Test*

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Introduction

During the eighteenth and nineteenth centuries visual and verbal images of the scientist were many and varied. Caricaturists, cartoonists, artists, and writers produced a diverse range of stereotypic figures: diabolical madmen, distinguished professors, harmless eccentrics, learned buffoons, and fashionable dilettantes. Naturalists in the field among flora and fauna were often pictured, as were physical scientists in their laboratories surrounded by vials and beakers. Cartoonists frequently portrayed scientists in controversy: disputing among themselves or in conflict with religious authority (Sherwood, 1970). And, of course, for centuries alchemy and black magic were invoked by caricaturists to lampoon the profession of chemistry.

With a few exceptions, these images are now seldom seen. As science has transformed its organizational structure, improved its general social status, and firmly established its social authority, a new professional image has emerged in the popular media. This image, apparently more in keeping with the institutional goals and procedures of modern science, differs in significant ways from earlier stereotypes. The naturalist has been almost entirely displaced by the laboratory scientist. Reference to alchemy and sorcery has all but disappeared. Controversy rarely reaches the public arena, though in recent years this element has begun to reappear especially in connection with environmental issues. In short, the image has been "cleaned up" and, in a sense, standardized.

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The first attempt to describe systematically this new standard image was Mead and Metraux's study (1975, pp. 386, 387) of its presence in a population of American high school students. The composite portrait which they drew, based on their research, remains the most succinct and useful description in the literature.

> The scientist is a man who wears a white coat and works in a laboratory. He is elderly or middle aged and wears glasses . . . he may wear a beard . . . he is surrounded by equipment: test tubes, bunsen burners, flasks and bottles, a jungle gym of blown glass tubes and weird machines with dials . . . he writes neatly in black notebooks . . . One day he may straighten up and shout: "I've found it! I've found it!" . . . Through his work people will have new and better products . . . he has to keep dangerous secrets . . . his work may be dangerous . . . he is always reading a book.

In its most highly refined form, the standard image may be seen in printed and televised advertisements designed to sell products or to enhance the prestige of science-related companies. Indeed, this familiar stereotype is central to advertising symbology as a device for associating commercial claims with the epistemologically privileged position held by science: an objective enterprise offering reliable truths and done for the service and benefit of mankind. Quite naturally, the image constructed by such symbol makers systematically selects certain visual elements (and eliminates others) historically associated with science.

Basalla (1976) offers an image which he calls "identical" to that of Mead and Metraux. Moreover, he finds that the essential characteristics of the popular stereotype remained stable throughout the period 1945–1975. He further speculates that the image has changed little since the beginning of the century, though his own research concentrates on the post-war period.

Basalla's article explores not only the standard (or "pop") image, but also the origin and influence of a number of alternative images, such as those of Mary Shelley's *Frankenstein* and HAL, the computer which personifies the scientific intellect in Arthur C. Clarke and Stanley Kubrick's *2001*. Such allegorical figures, historically and culturally older and more profound than the standard image, are also incomparably richer in depicting the complexities of mankind's reaction to science. Frankenstein, Jekyll/Hyde, Faust, Adam and Eve, and many of the earlier myths and legends speak directly to the question of natural knowledge and human power in relation to good and evil.

The modern sanitized standard image has never fully replaced the older mythic images of the "man of knowledge," yet it has achieved a ubiquitous and relatively unambiguous place in the forefront of the twentieth century mind. (A systematic study, by the author, of the image of the scientist in magazines and posters of the People's Republic of China showed only a few deviations from the western image: far more women and younger beardless men.)

The standard image, though it has been considered so, is not simply a child's image. It is the picture inevitably drawn by adults who wish to convey graphically the concept "scientist." Every element of the standard image either portrays directly some part of the scientist's actual world or else may be taken as symbolic of some part of that world. Thus, it should be no surprise that, when asked to "draw a scientist," even scientists themselves utilize the standard image.

Consider for a moment the symbolic value of each of the key elements in the Mead–Metraux stereotype. Eyeglasses, for example, are associated with eye strain (and thus intense observation). Lab coats are associated with dirty work (and thus experimentation and empirical knowledge), but also with purity (functioning symbolically as priestly white robes). Beards may be seen as meaning "unshaven" (working long and unusual hours) or may represent, as suggested by Mead and Metraux, "deviation from the accepted way of life" (and indeed the scientific community is set apart enough to be studied as a distinct subculture); or, finally, beards may represent wisdom and possession of knowledge.

How early does this image first make its appearance? At what age do standard and mythic images begin to penetrate the child's consciousness? Most image and attitude studies relating to the scientist have been concerned with college students or adolescents (Mead & Metraux, 1957; Beardslee & O'Dowd, 1961; Rodriguez, 1975; Gardner, 1975). A few studies have attempted to identify and even measure attitudes of older children (Lowery, 1967; Krause, 1976). No one apparently has demonstrated precisely when these images initially appear.

Objectives

The objective of this study was to determine at what age children first develop distinctive images of the scientist. In addition, a preliminary attempt was made to clarify the influence of such population variables as socio-economic class, intelligence, sex, and Anglophone/Francophone culture on the formation of the standard image. We also looked for specific variations of the stereotype which might indicate the early development of social and psychological attitudes toward science and technology. Finally, we explored the first appearance of some of the mythic images of the scientist.

Methodology: The Draw-a-Scientist-Test

The research took place over a period of 11 years (1966–1977). At first, a variety of procedures was tried, but by far the most fruitful proved to be what we now call the Draw-a-Scientist Test (DAST). Mead and Metraux (1957) suggested the idea, but the procedures outlined below were developed by the present author. It is important to note that the Draw-a-Scientist Test is not merely an extension of the Draw-a-Man or the Draw-a-Person tests which have been used as projective instruments designed to reveal the drawer's intelligence or his/her self-image or certain emotional states or conflicts (Goodenough 1926; Goodenow, 1977; Harris, 1963).

Procedures

The DAST was administered in the classroom by the regular teacher, who, without any previous discussion whatever, asked the children, working separately, to "draw a picture of a scientist." As a control, 912 of the children (18.9% of the sample) were asked to "draw a person" before being asked to "draw a scientist."

For the purpose of the investigation, the elements of the "standard image" were determined *in advance*, and only those listed below were counted as indicating its appearance or partial appearance. Initially, an attempt was made to label each drawing as "positive overall" or "negative overall," but this procedure was abandoned as entirely too subjective.

The principal investigator was aided in the collection and interpretation of the drawings by a total of 81 undergraduate students over the course of 11 years.

Subjects

The Draw-a-Scientist Test was administered to 4807 children in 186 classes from kindergarten to grade five (approximately five to eleven years old). The majority were from grades two and three. Most of the schools were located in Montreal, Quebec (13% of these children were French-speaking and 87% were English-speaking. These percentages are, by coincidence, approximately the reverse of those in the general population). Other schools were drawn from the Province of Ontario, the states of Texas, Oklahoma, Connecticut, New York, and Vermont in the U.S., and the state of Victoria in Australia. An attempt was made to classify the schools according to the following socio-economic categories: (a) clearly upper to upper-middle income, (b) mixed or middle income, and (c) clearly lower income. Whenever classification was in doubt, the school was placed in the middle category.

Analysis of Drawings

Based partly on the literature, the following were chosen as indicators of the standard image of a scientist:

(1) Lab coat (usually but not necessarily white).
(2) Eyeglasses
(3) Facial growth of hair (including beards, mustaches, or abnormally long sideburns).
(4) Symbols of research: scientific instruments and laboratory equipment of any kind.
(5) Symbols of knowledge: principally books and filing cabinets.
(6) Technology: the "products" of science.
(7) Relevant captions: formulae, taxonomic classification, the "eureka"! syndrome, etc.

Thus, seven types of indicators were chosen. Each drawing was analyzed and given a score from one to seven to indicate the extent to which the standard image was present. The appearance in a drawing of several indicators of the same type did not influence the score; that is, two scientists, each with eyeglasses, counted as one indicator. Similarly, three scientific instruments on a table counted as one indicator. The individual scores were first summed for each school class and then summed and averaged for each grade level. In the control drawings (in which the children were asked to "draw a person") none of the indicators were drawn with the exception of eyeglasses in 5 cases (or ca. 0.5%) and facial hair in 14 cases (or ca. 1.5%).

In interpreting the drawings several components, other than the seven indicators, were noted and their possible significance considered. These include size of scientific instrument in relation to scientist, indications of danger, presence of light bulbs, underground laboratories, male/female figures, and elements of mythic stereotypes (such as Frankenstein creatures and Jekyll/Hyde figures).

Results

The Standard Image

With occasional exceptions, kindergarten and first grade children draw almost none of the seven indicators (see Table I). By the second grade, however, the stereotype has begun to take root. It was not unusual for a majority of second grade pupils in a class to incorporate at least two elements of the standard image. Third grade children are even more likely to include larger numbers of the indicators. By the fifth grade, the majority in a class are likely to show at least three or four types of indicators with a few pictures exhibiting six or seven. In a small sample of adults (including some scientists) who were given the DAST, the average drawing included between four and five of the indicators.

Lab coats, eyeglasses, growth of facial hair, and laboratory equipment began to appear in the drawings of the youngest children. Instruments and equipment were mostly chemical, especially in early years, but gradually more sophisticated items such as microscopes, telescopes and computers appeared. Symbols of "science as process" included not only research tools, but also the scientist in exultant stance shouting "I've done it"! or "I made a discovery"! or simply "Wow"! Much less frequently, we found symbols of

Table I
Standard Image: Frequency and Mean Indicators per Student by Grade Level[a]

	Sample Size	Number of Indicators	Mean Indicators Per Student
Kindergarten	45	14	.31
First Grade	842	594	.71
Second Grade	1,222	2,291	1.81
Third Grade	1,284	3,123	2.43
Fourth Grade	946	2,883	3.05
Fifth Grade	468	1,524	3.26

[a] The data presented in this table, each of the following tables, and the figure, have not been subjected to final tests of significance and measures of association at this writing. In a technical paper to follow this article, the author plans to describe the statistical significance of the differences in the mean number of indicators per student by grade and by socio-economic status. In addition, an analysis of the strength of the relationship between grade level and the mean number of indicators per student will be performed. A similar assessment of the strength of the relationship between socio-economic status and the mean indicators per student will be developed. Last, the technical paper will measure the emergence of the image of a scientist at each grade level by examining the data present in Figure 1 of this article.

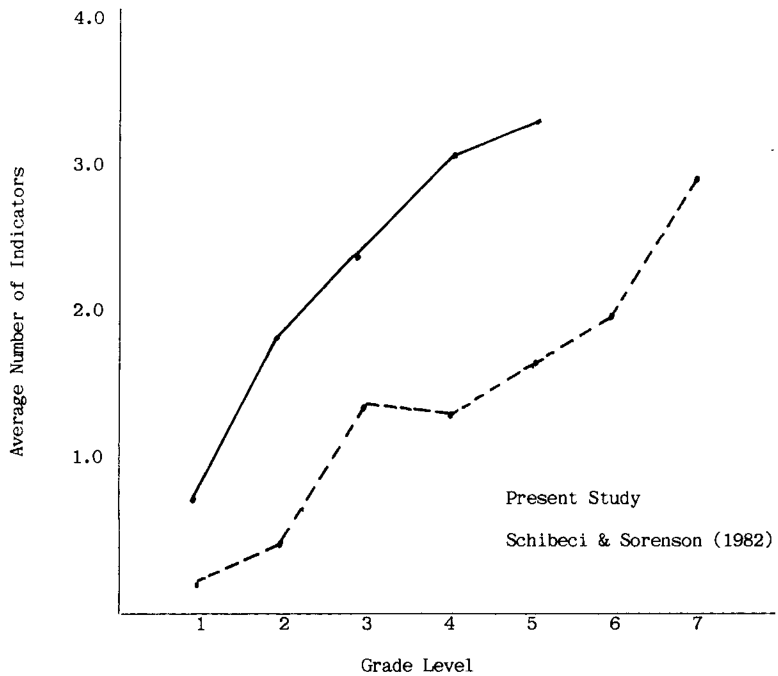

Figure 1. Standard image: two study comparison of mean indicators per student by grade level.

science as recorded knowledge—the scientist as record keeper or accumulator of knowledge: writing in a notebook, seated at a desk with filing cabinets (or shelves of books) all around, or reading some sort of report. In some drawings, especially those of older children, a principal symbol of science is technology. Thus, piled around the laboratory, we may find its products: television sets, a stack of telephones, a helicopter or missiles overhead, electric wires, and in at least one case a futuristic car parked behind the lab bench.

Thus, as seen in Figure 1, the average number of indicators per child tends to increase with grade level. A recent independent study (Schibeci & Sorenson, 1982) designed to examine the usefulness and reliability of the DAST, found a similar trend in a population of 463 children in grades one to seven. These data seem to show that the standard image has begun to appear in the child's consciousness in the second and third year of schooling; by the fourth and fifth year the image, as a rule, has fully emerged. Some variations in this pattern are discussed below.

Population Variables

Attempts were made to draw comparisons on the basis of several population variables, but in the main the details of the standard image were constant.

(1) Socio-economic differences. There was a remarkably clear relationship between the number of indicators found and the socioeconomic classification of the school (see Table II). The standard image was slower to appear in lower income schools, and in a few such schools the image was almost totally absent until the fourth or fifth grades. At

Table II
Standard Image: Comparison of Mean Indicators at Each Grade Level with Socio-Economic Status of Schools

		GRADES				
		1st	2nd	3rd	4th	5th
SCHOOLS	Upper Income	1.30	2.27	3.01	4.03	4.10
	Mixed/ Middle Income	.69	1.89	2.57	3.12	3.46
	Lower Income	.35	1.41	1.56	2.17	2.89
	Total Sample	.71	1.81	2.43	3.05	3.26

first, these results may seem somewhat surprising, if one assumes that all classes have access to comic strips and television, the supposed sources of the image; however, the effect may be explained at least in part by the fact that lower income drawings were, in general, less detailed overall. Our finding is thus also consistent with the hypothesis of a correlation between family income and intelligence as measured by the Draw-a-Man test. Therefore, valid generalization based on socio-economic data would require tighter and more consistently applied controls of I.Q., drawing skills, and socio-economic status at each grade level in any further testing. The present study indicates only that such further testing might prove interesting.

Although no quantitative analysis was attempted, investigators received the impression that lower income children may have been more likely to draw large instruments in relation to the size of the scientist, while the reverse may have been true for upper and middle income children. A further impression was that upper income children tended to produce a more detailed and sophisticated array of scientific instruments, suggesting a better understanding of what science is about and the range of scientific concerns. These subjective observations might form the basis for further tests, especially at the advanced grade levels.

(2) **Sex differences.** Only girls drew women scientists. Twenty-eight women scientists were drawn, all by girls (who constituted 49% of the sample). Girls were less likely to associate science with war and more likely to fear accidents in connection with research. (See discussion of alternative images below.)

(3) **Intelligence differences.** The Draw-a-Man test for intelligence, developed by Florence Goodenough, is, of course, built into the DAST. (Goodenough, 1926; Harris, 1963). In spite of doubts about the validity of this measure (see especially Kellogg, 1969), an effort was made to identify those drawings in our sample which were made by highly intelligent children. Based on this determination, as might be anticipated, high IQ children

tended to produce the standard image at an earlier age in those groups tested for intelligence. This result must be related to the fact that nearly one half the children who exhibited higher scores on the Draw-a-Man test were from schools in the high socio-economic class. Because of the small number of our pupils that were given the Draw-a-Man IQ test, because of uncertainties about the validity of the IQ test, and because in this study IQ tests were not professionally administered, no firm conclusion regarding the importance of intelligence can be determined from our data. As indicated earlier, however, we believe interesting results might be obtained in future studies whose experimental design more systematically controlled these factors.

(4) **French/English differences.** French and English Canadian drawings were very much alike. There was some indication that French-speaking children were more likely to draw naturalists, astronauts, and women. The French term used for scientist was "homme de science." (See discussion of alternative images below.)

Alternative Images

Alternative images, closely related to the mythic stereotypes discussed by Basalla (1976), began to appear at the same time as the standard image (see Table III). While an exceedingly small portion of children perceived scientists in these alternative ways (such images occurred in 3.5% of the drawings), the significance of mythic images surely lies in their persistence and regularity of occurrence. In all geographic locations, it was common for at least one child in each class to present an alternative stereotype to that of the standard image. The alternatives included clear representations of the Jekyll/Hyde and Frankenstein legends, magical portrayals of alchemical laboratories, the frightening

Table III
Alternative Images: Frequency and Percentage Distributions by Grade Level

	Sample Size	Number Alternative Images	Percent
Kindergarten	45	0	0
First Grade	842	6	0.7
Second Grade	1,222	41	3.4
Third Grade	1,284	58	4.5
Fourth Grade	946	42*	4.4
Fifth Grade	468	23	4.9
Total	4,807	170	3.5

* First round only.

visions of clearly deranged (sometimes labeled "mad") scientists testing, for example, new improved versions of the electric chair. Discussions with teachers and the evidence of the drawings themselves produced no indication of correlation between the drawing of alternative images and possible emotional disturbance in the child. In all those cases in which teachers felt they could identify emotional problems, alternative images (as discussed above) were not drawn.

It seems probable that alternative images are familiar to a much larger proportion of the children than was discovered by the DAST. In one fourth grade class, the 24 pupils, after completing their drawings, were instructed to "draw another scientist." In the first set of drawings, no mythic stereotypes appeared and only one of the drawings incorporated elements of a morally dubious nature. The second set of drawings produced two Frankensteins along with nine pictures that included such clearly dangerous elements as bombs, poisons, and a scientist with test tube held high exclaiming: "With this I destroy the world"! This may indicate that nearly half the children in this class felt a certain ambivalence about the social value of science which did not emerge in their first drawing. The result was totally unexpected since the intention of this variation in procedure had been to elicit possible distinctions among scientific specialties. In fact, no such distinctions were clearly found.

It was interesting to discover that in a small number (less than 1%) of cases of both standard and mythic images, laboratories in the drawings were located in what were almost certainly underground chambers. This might be taken as a manifestation of what I. B. Cohen has called the "basement tradition" in the history of chemistry (Cohen, 1950, p. 73). When Benjamin Siliman discovered, in 1803, that his new lab at Yale had been constructed in a subterranean room, he commented that the "architect . . . had received only some vague impressions of chemistry, perhaps a confused and terrific dream of alchemy, with its black arts, its explosions, and its weird-like mysteries. He appears, therefore, to have imagined that the deeper down in mother earth the dangerous chemists could be buried, so much the better" (Fulton & Thompson, 1969, pp. 33, 34). Such "confused and terrific dreams" still influence some children who draw basement labs complete with staircases, tiny ground level windows (sometimes barred), and occasionally, spiders and vampire bats.

Whether upstairs or down, a scientist always works indoors. Conspicuous by his absence was the naturalist, the explorer, the scientist who studies nature as he or she finds it in the wilderness. Only seven children out of 4165 (0.2%) in English-speaking schools drew such pictures. Sixteen out of 642 (2.5%) French-speaking children, and three out of 67 Australians (4.5%) associated the scientist with "nature."

Some children in both the U.S. and Canada seem to associate science directly with war and armaments. This association was taken for the purposes of this study as a special case of indicator six above: technology as a symbol of the products of scientific research. One hundred forty-one boys and four girls (2.9% of the sample) clearly connected science with guns, bombs, or armed missiles. Almost all of these were in the third grade or higher. Chemical and biological warfare has evidently not yet penetrated the comic strips since these subtleties escaped the children, with a few exceptions, such as the fifth grader who offered the following labels for the drawers of a filing cabinet: NEW GERMS FOR NEW DISEASES, NEW CHEMICALS FOR NEW POLUSHUN, and appropriately, NEW HEADS FOR NEW PEOPLE. Very few children (less than 2%) connected scientists with pollution or the environmental crisis, and most of those who did tended to identify scientists as saviors rather than devils.

Another occasional theme in the drawings was the fear of explosions or of breaking fragile equipment. Such concerns ranged from the scientist accidentally dropping a test tube to the scientist standing amazed with his lab in ruins at his feet. One hundred and ninety-seven children (4.1%), including 112 girls and 85 boys, presented such pictures.

It is possible to compare the child's image with certain aspects of the corporate self image of the scientific community. For example, whereas most scientists think of science as completely open emphasizing the importance of early communication of results, some children seem to associate science with secrecy and restricted information. Robert Merton and other sociologists have suggested that scientists place great emphasis on the openness and "communality" of the scientific community. They claim that, in science, discoveries are communally owned; secrecy is an anathema, an immoral act, resorted to "only temporarily as 'a dire necessity' in the interest of sheet survival" (Barber, 1952, p. 91). These distinctions seem a trifle overdrawn in light of the extensive classified research conducted in American universities, to say nothing of military or industrial research labs. An editor of the British journal *New Scientist* made this comment: "One of the serious defects surrounding science throughout the world is the neurotic degree of secrecy which envelopes so much decision-making—even when no considerations of military or national security are involved" (Dixon, 1976).

Whatever may be the ideals of science, science means secrecy to some children. In almost every third to fifth grade class tested, at least one child (and occasionally as many as four or five) drew signs on the doors and walls of the laboratory bearing such messages as "Keep Out!", "Private," "Do Not Enter," "Go Away," and "Top Secret." The great majority of children do not, of course, draw such labels, but some scientists must feel a certain amount of discomfort on seeing a third grade drawing of a laboratory labelled: SIKRIT STUFF FOR SIKRIT ENVINSHUNS—SIKRIT.

Conclusions

Two major conclusions may be drawn from this study:

(1) The stereotypic image of the scientist, which Mead and Metraux examined in high school students, was also found to appear among students at the grade school level.

(2) The evidence indicates that the various elements of the stereotype appear with greater frequency as students advance through the grades.

The strengths and weaknesses of the Draw-a-Scientist Test for identifying and assessing professional stereotypes in young children may be summarized as follows:

(1) Because DAST does not rely on verbal response, it can be utilized at an earlier age than other attitude measuring tests. This factor also enables comparison of different language groups without significant translation problems.

(2) Because a large literature now exists on the significance of human figure drawing in children, it is possible that interesting correlations may be found between children's images of scientists and other social and psychological parameters.

(3) DAST is easier to administer than most tests; however, a number of interpretive difficulties may arise.

(4) DAST is probably more useful in identifying than in measuring attitudes. Therefore, it may ultimately prove more useful in the construction of hypotheses than in the testing of them.

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References

Arnheim, R. *Art and visual perception.* Berkeley: University of California Press, 1975.

Ashton, B. G., & Meredith, H. M. The attitudes of sixth-formers to science and scientists, *Sch. Sci. Rev.*, 1969, *51*, 174.

Barber, B. *Science and the social order.* Glencoe: The Free Press, 1952.

Basalla, G. Pop science: the depiction of science in popular culture. In *Science and its public*, G. Holton and W. Blanpied (Eds.). Dordrecht, Holland: D. Reidel, 1976.

Beardslee, D. C., & O'Dowd, D. D. The college-student image of the scientist, *Science*, 1961, *133*, 997–1001.

Cohen, I. B. *Some early tools of american science.* Cambridge: Harvard University Press, 1950.

Dixon, B. *What is science for?* Harmondsworth: Penguin, 1976.

Fulton, J. F., & Thomson, E. H. *Benjamin Silliman.* New York: Greenwood, 1969.

Gardner, H. *Artful scribbles.* New York: Basic Books, 1980.

Gardner, P. L. Attitudes to science: a review. *Stud. Sci. Educ.*, 1975, *2*, 1–41.

Goodenough, F. L. *Measurement of intelligence by drawings.* New York: Harcourt Brace, 1926.

Goodenow, J. *Children's drawing.* London: Open Books, 1977.

Harris, D. B. *Children's drawings as measures of intellectual maturity: A revision and extension of the Goodenough draw-a-man test.* New York: Harcourt Brace, 1963.

Kellogg, R. *Analyzing children's art.* Palo Alto: National Press Books, 1969.

Krause, J. P. How children "see" scientists, *Sci. Child.*, 1976, *14*, 9–10.

Lowery, L. F. An experimental investigation into the attitudes of fifth grade students toward science, *Sch. Sci. Math.*, 1967, *67*, 569–579.

Mead, M., & Metraux, R. The image of the scientist among high school students: a pilot study, *Science*, 1957, *126*, 384–390.

Rodriguez Sala de Gomezgil, M. L. Mexican adolescents' image of the scientist, *Soc. Stud. Sci.*, 1975, *5*, 355–361.

Schibeci, R. A., & Sorensen, I. Elementary school children's perception of scientists, 1982, typescript.

Sherwood, M. Caricatures of science. *New Sci.*, 1970, *47*, 382–384.

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