equally advantaged, would not have done as well. She does not ask whether the average Nobelist is smarter than other people.

Another quibble might be raised. Zuckerman relies primarily on material from biographical dictionaries, from formal Nobel proceedings, from interviews she has conducted with surviving laureates, and from sociometric studies. These resources are not always reliable; a wider reading of history might have prevented blunders at important points in the argument. To take but one example, the award of the prize in chemistry in 1904 to William Ramsay (rather than to Ramsay and Soddy) is not, as Zuckerman thinks, recognition of only the senior member of a collaboration. Ramsay won for his detection and isolation of the rare gases during the years 1894 to 1899; Soddy first worked with him in 1903, on the chemistry of radon.

Zuckerman's statistical tables are well constructed and easily read. Her elucidations are commonsensical. They are also often banal ("There is evidence that a small number of scientists contribute disproportionately to science"; "Their responses in the long run and the impact of the prize on their careers depend in some measure on how old they were when they got it.") The cause might be that her numbers do not sum to a distinctive group portrait: they might also characterize Supreme Court Justices, officers of the American Medical Association, or members of the President's cabinet. Or, as Zuckerman puts the point: "It may be that evocative environments [elite schools, distinguished professors, good resources] enhance opportunities for doing excellent science in ways that are formally akin to the mutually reinforcing effects of environments with high crime rates where vulnerable individuals become criminals." Precisely. But the problem is not to report the rates, but to characterize the vulnerability, to look for the traits (if any) that predispose people to commit the sort of crime that brings the Nobel prize.

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Unfoldings of Mental Life

Intelligence in Ape and Man. DAVID PREMACK. Erlbaum, Hillsdale, N.J., 1976 (distributor, Halsted [Wiley], New York). xiv, 370 pp., illus. $16.50.

Language Learning by a Chimpanzee. The LANA Project. DUANE M. RUMBAUGH, Ed. Academic Press, New York, 1977. xxii, 312 pp., illus. $17.50. Communication and Behavior.

In 1885 Sir John Lubbock, Lord Avebury, reported to the British Association for the Advancement of Science a "Note on the Intelligence of the Dog":

> Hitherto we have tried to teach animals, rather than to learn from them: to convey our ideas to them rather than to devise any language or code of signals by means of which they might communicate theirs to us. The former may be more important from a utilitarian point of view—though even this is questionable—but psychologically it is far less interesting. Under these circumstances, it occurred to me that some such system as that followed with deaf mutes, and especially by Dr. Howe with Laura Bridgman, might prove instructive, if adapted to the case of dogs.

So it came about, nearly a hundred years ago, that an English gentleman attempted to pass on the torch of language not to a chimpanzee but to a black poodle called Van. Lord Avebury's method of teaching his dog to "read" and "write" was remarkably close to that which was later to be used by David Premack in his early experiments with the chimpanzee Sarah. In honor of the dog and man, it seems proper to quote the original paper at some length:

> I have tried this in a small way with a black poodle called Van, by taking two pieces of cardboard, about ten inches by three, and printing on one of them in large letters the word "food," leaving the other blank. I then placed two cards over two saucers, and in the one under the "food" card I put a little bread and milk, which Van, after having his attention called to the card, was allowed to eat. This was repeated until, in about ten days, he began to distinguish between the two cards. I then put them on the floor, and made him bring them to me, which he did readily enough. When he brought the plain card I simply threw it back, while when he brought the "food" card I gave him a piece of bread, and in about a month he had pretty well learned to realise the difference. I then had some other cards printed with the words "out," "tea," "bone," "water," and a certain number also with words to which I did not intend him to attach any significance, such as "naught," "plain," "ball," &c. He soon learnt that bringing a card was a request, and to distinguish between the plain and printed cards; it took him longer to realise the difference between words, but he gradually got to recognise several. If he were asked whether he would like to go out, he would joyfully pick up the "out" card, choosing it from several others, and would bring it to me, or run with it in evident triumph to the door. The cards were not always put in the same places, but were varied indiscriminately, and in a great variety of positions. Nor could the dog recognise them by scent, for they were all alike, and continually handled by us. Still I did not trust to that alone, but had a number printed for each word. When, for instance, he brought a card with "food" on it, we did not put down the identical card, but another bearing the same word; when he had brought that, a third, then a fourth, and so on. For a single meal, therefore, eighteen or twenty cards would be used, so that he evidently was not guided by scent. No one who has seen him look down a row of cards and pick up the one he wanted, could, I think, doubt that in bringing a card he feels he is making a request, and that he can not only distinguish one card from another, but also associate the word and the object. This is, of course, only a beginning, but it is, I venture to think, suggestive, and might be carried further, though the limited wants and aspirations of the animal constitute a great difficulty. [*Report of the British Association for the Advancement of Science*, 1885, p. 1089; see also *The Life-Work of Lord Avebury* (Watts, London, 1924)]

Fortunately the wants and aspirations of the chimpanzee are not so limited. Indeed, the chimpanzee's eagerness to learn and to exploit its new-found skills has contributed as much as its native intelligence to the success of recent attempts to teach it language. For Premack's and Rumbaugh's chimpanzees the playroom has been the schoolroom, the schoolroom the playroom. When Rumbaugh and his colleagues have wished on rare occasions to punish their chimpanzee Lana the worst thing they could think of doing to her was to switch off her electric "typewriter."

But another, more insidious limitation has until recently shackled the efforts of psychologists to teach language to nonhuman animals: lack of faith that anything would come of it. Before the Gardners' pioneering experiments with Washoe few people seriously believed that a chimpanzee could be trained to communicate with human beings in human language. A few eccentrics might have dreamed of it, but almost no one who valued his scientific reputation would have committed himself to a full-scale research program to demonstrate it. The reason lies deep within us all: our lack of faith in the linguistic abilities of animals is founded on our faith in the uniqueness of ourselves.

Such faith is not of course unjustified. It is a fact of nature, no mere fiction of human ideology, that people are pro-

foundly different from animals. Common experience tells us that in the world as we know it all human beings have language, no animals do. But it is easy to be blind to the special circumstances that bring about the seemingly god-given division between men and animals. It is not god-given, not even to the extent that god works through our genes: it is a product in large part of human culture. Take away culture, take away the privileges of human education, and man's mind, like his naked body, is not so different from an ape's. A man will not learn to speak unless he has been spoken to.

The corollary is shockingly simple: expose an ape's mind to human culture and it may begin to take on human qualities. Speak to an ape in the right way and perhaps it will speak back.

Yet the reality of the ape-to-human transformation continues to prove startling, as much to the chimpanzees' teachers as to the rest of us who read of their experiments. Even now, with the evidence of their own and the Gardners' success before their eyes, Premack and Rumbaugh express in their books astonishment at what they themselves have revealed. The folded paper flower has lain in the cupboard all these years: place it in a glass of water and it blossoms.

Premack's book provides a detailed history of his work with Sarah, corroborated by the evidence obtained with three less gifted chimpanzees. The focus of the book is on the development of a "reading" and "writing" system based on the use of plastic symbols stuck to a board; the author also describes important experiments, using more conventional techniques, designed to probe the ways in which chimpanzees conceptualize the world around them. The book edited by Rumbaugh reports the findings of the LANA project (LANA is an acronym for LANguage Analogue Project as well as the name of a young chimpanzee), whose aim was to develop a computer-based language system in which messages, formed as strings of ideograms, could be typed on a keyboard and read from a visual display.

In many respects the two books cover similar ground: both report an intensive study of a single chimpanzee that has been taught to communicate with human beings through the medium of an "artificial" visual language. Yet the two projects and the books describing them each have a very different feel. Premack's approach was from the start idiosyncratic and opportunistic—he followed his nose where the scent for a good problem led him. The LANA project, begun a few years later, was much more carefully planned. It was conceived as a piece of collaborative research bringing together the skills of linguists, computer programmers, and comparative psychologists in an attempt to provide optimum conditions for promoting linguistic interchange and for recording what occurred.

Anyone who finds both books on his desk and like me is inclined to taste the juicier-looking morsel first will probably turn first to Premack. A book called *Intelligence in Ape and Man*, written by a single author, promises to be more entertaining than a compilation of papers called *Language Learning by a Chimpanzee*. Such an assessment would be quite mistaken. While the story Premack tells is extraordinarily interesting he has not in fact succeeded in writing a good book. The book is unnecessarily wordy and its argument is in places hard to follow: too many raw data (ten trials on this problem, twelve trials on that), too much space given to inconclusive anecdotes, too much spoon-fed and sometimes almost force-fed interpretation. Given that so much of Premack's material is gold it is a pity that he has allowed himself to contaminate it with such a lot of baser metal. Many readers may be tempted to give up through sheer exhaustion. And if they continue to the end they may begin to suspect that the author himself has never read his book from cover to cover: I was a bit depressed to find the very same sentences repeated word for word on, for example, pp. 132 and 353.

It was with some relief that I turned to Rumbaugh's volume. Here, from the opening chapter onward, one is in a world not only of adventure but of careful scholarship. Whereas I had felt hustled by Premack, I now found myself being willingly seduced. The book develops as the project did, through a historical survey of theories about the origin of human language, followed by discussion of the meaning of communication and of the previously known potential of the ape, then on to an account of the "Yerkish" language with details of the computer programs and training methods; and so to the chimpanzee's linguistic achievements—including details of conversations, both spontaneous and manipulated, her system of color naming, and her elementary counting skills. The book, which is written as a series of essays by Rumbaugh and his colleagues, is as a whole fluent and rounded. The unity of purpose and thinking that characterizes the separate contributions must, I suspect, have been present in the day-to-day running of the project and have been responsible in large measure for its success.

The chimpanzee has been taught to use a verbal language. That fact in itself is remarkable. But if that was all there was to it the chimpanzee's achievement would stand as a fact to be recorded in the *Guinness Book of World Records* rather than as a major contribution to natural science. The real promise of these experiments lies in what they will tell—the chimpanzee itself will tell—about its conceptual model of the outside world. Through the use of symbolic forms the chimpanzee has been induced, albeit in a limited way, to give public expression to its thought processes—to reveal how it categorizes objects, how it perceives relations between events in space and time, how it thinks of agency and causation, how it conceives of its own body. Both Premack and Rumbaugh believe that the conceptual system they are beginning to uncover is essentially prelinguistic. The chimpanzee does not—as yet—"think in words" but rather uses language as a means of creating a symbolic map of the ideas that are already in its mind. The implications for understanding human preverbal and nonverbal thinking are profound.

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Comparative Studies

Evolution of Brain and Behavior in Vertebrates. Papers from a conference, Tallahassee, Fla., Feb. 1973. R. B. MASTERTON, C. B. G. CAMPBELL, M. E. BITTERMAN, and NICHOLAS HOTTON, Eds. Erlbaum, Hillsdale, N.J., 1976 (distributor, Halsted [Wiley], New York). xiv, 482 pp., illus. $29.95.

Evolution, Brain, and Behavior. Persistent Problems. R. B. MASTERTON, WILLIAM HODOS, and HARRY JERISON, Eds. Erlbaum, Hillsdale, N.J., 1976 (distributor, Halsted [Wiley], New York). x, 276 pp., illus. $14.95.

Although the fields of paleontology, comparative neurology, and comparative psychology have much to learn from one another, there has been far too little fruitful interaction. This pair of volumes should stimulate such interaction. Although most of the papers they include relate strongly to one of the three disciplines, the individual authors are clearly aware of the contributions of the other fields, and the papers are written for readers outside their authors' specialties. The first volume has four chapters on the origins and radiations of vertebrates, seven chapters on comparative anatomy, and eight chapters on learning, sensory abilities, and other aspects of behavior. The shorter, more theoretical second vol-