PSYCHOLOGISTS AND PSYCHOLOGY

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I

People who are not psychologists—and this includes scientists and scholars as well as others—often have somewhat odd ideas about what psychologists are and do. Some of them think we are magicians who can penetrate the inmost secrets of their personalities in a short conversation, and that it would be wise to be very much on guard when talking to us. We thank them for the implied compliment, and we wish their fears of us were not quite as groundless as they actually are! What makes Johnny tick—Johnny the individual, that is, in contrast to John Doe, the average man—is almost as much a mystery to us in ordinary circumstances as it is to anyone else. If we really want to know we ask Johnny himself, frequently over a period of days or weeks, and even here our only real advantage over non-psychologists is that we can ask just slightly more pertinent questions, and interpret his answers a little more objectively, because we know in advance how John Doe answers the same questions.

Another picture of the psychologist represents him as pseudo-scientist, who sets up elaborate experiments to prove something which everybody knows already or which is so trivial as not to need proof anyhow, and then reports the results in his own peculiar brand of gobbledegook. Thus he may be represented as having published a paper entitled "Verbal and overt reactions of men and women to unexpected mild nociceptive stimulation," when what he actually did was stand on a street corner, jab every fiftieth passing pedestrian with a pin, measure how far he jumped, record whether he said "ouch" or "damn," and then by elaborate statistical analysis show that the men jumped significantly farther than did the women, and were relatively more likely to respond verbally by saying "damn." I must confess that there is more than just the inevitable grain of truth in this picture. Psychologists do perform a lot of rather obvious and trivial experiments. They do so for two reasons. The first is that moral as well as financial considerations prevent their performing many really important types of research, such as separating 100 pairs of identical twins at birth and having one set reared in one type of environment and the other set in a different type, so that 30 or 40 years later an intensive study of the abilities and personalities of the two groups would reveal the actual effects of the differences between the two environments. The second and more important reason is that *occasionally* some apparently trivial or obvious study gives the wrong answer, and some fact or principle long accepted by everybody as quite obviously true turns out to be false. Thus, to stay within the realm of the trivial, waving a red flag at a bull has no more effect upon his disposition than waving a flag of any other color. A somewhat laborious experiment carried out years ago showed that bulls are color-blind! Or to depart from the trivial, Emerson's "Essay on Compensation" may be great literature, but it is bad psychology. There is practically no good trait whose possession is associated significantly oftener than chance with any bad trait whatsoever. Hence the sum total of the good traits minus the bad traits of one person may very greatly exceed the sum total of the good traits minus the bad traits of another. Or as Pat expressed it to Mike, "One man is as good as another—and sometimes a darn sight better." The evidence is about a million correlation coefficients in the psychological literature, about one per cent significantly negative.

The third picture represents the psychologist as a mild screwball—someone who needs a bit of psychotherapy himself but who, having subscribed to the opinion represented by the first picture, decided to study psychology instead of seeking clinical assistance. The picture clearly indicates that he didn't profit by his psychological studies! There really are such students in our undergraduate courses, but they rarely continue long enough to become psychologists. The few who do are those whose problems were mild enough to solve themselves with time, and who then develop a real interest in psychology *per se*. One sophomore student who held this third opinion wrote on an anonymous teacher-evaluation questionnaire, "Is he a typical psychologist? NO. His appearance and manner is very normal."

It is interesting to note that any two or all three of these opinions about psychologists may be held by the same perfectly normal and intelligent person simultaneously. Such is the known illogicality of man, and his ability to preserve his prejudices inviolate from contamination by mere evidence and considerations of consistency.

If these pictures do not tell the story, what does? What is psychology, and what sorts of persons are psychologists? To answer the second question first, there are in general two varieties of psychologists. Those of the first variety resemble scientists in general. They have the same patterns of likes and dislikes as other scientists. On the average they probably have about the same intelligence, though their scores on tests are higher because they know too many tricks of the test-taking trade. They share the scientist's peculiar preference for abstract ideas over neighborhood gossip, the great game of politics, and the most recent Hollywood scandal. They even share the scientist's weird tolerance for painstaking laboratory work, monotonous computing, and hard straight thinking which he doesn't have to do merely to earn his living. They do not necessarily care much for people as persons, and they often prefer to study white rats, which can be and are separated into groups of matched heredity at weaning, if not at birth, and reared in closely controlled environments.

Those of the second variety more or less resemble social workers and physicians in their basic patterns of likes and dislikes. They are more interested in people as persons than in ideas as such. Their primary goals are professional service rather than scientific research. Their verbal aptitudes are as high or higher than those of the scientist variety, but their mathematical and mechanical aptitudes are a little l o w e r. While the psychological scientists end up in unversities, government laboratories, and consulting firms, the professional psychologists find their way into hospitals, clinics, and personnel departments in industry and government, not to mention jails, where, however, they are usually on the staff rather than behind the bars!

Just to set the record straight, I myself belong to the former variety. Every aptitude test battery I have ever taken has told me I should have been an engineer, or better yet a mechanic. Over the years my pattern of likes and dislikes for 400-odd occupations, avocations, types of people, etc., has consistently been closer to that of chemists than to that of psychologists in general. My memory for names and faces is abominable, but my memory for statistical formulas is good. I have never offered professional counsel to an individual, and I never intend to.

II

We can divide psychological science into the broad areas of normal human psychology, animal psychology, social psychology, abnormal psychology, and differential psychology, this last being the psychology of individual and group differences. Applied psychology, in turn, comprises several distinct professions—clinical psychology, personnel psychology, industrial psychology, engineering psychology, counseling psychology, and survey psychology—each with some dozens to hundreds of parctitioners over the nation.

Let us take first a brief glimpse at normal human and animal psychology; the two are seldom separated in practice. The first topic, both logically and historically, deals with the sensory and perceptual processes of bulls and mice and men. We learn, for example, that Aristotle very greatly underestimated the number of human senses. We have not only a sixth sense, but even a sixteenth. There are at least two varieties of vision: central vision which includes color vision and spatial discrimination, and peripheral vision which, when night-adapted, is 10,000 times as sensitive as day vision, reaching to the point of a distinct sensory response to the impact of as few as 5 to 14 photons upon the retina. Then we have hearing with a range of 12 or

14 octaves to vision's two, but only the crudest spatial orientation based on binaural differences in intensity and phase. There are the five skin senses: touch or light pressure, deep pressure, warm, cold, and pain. Biting cold, hot, burning hot, itch, tickle, etc., are either combinations or temporal and spatial patterns of these five. There are four basic tastes: sweet, sour, salty, and bitter, supplemented by the skin senses which are also present in the mouth and by the 4 to possibly 6 or 8 senses of smell, which latter give food most of its flavor. We have organs of static balance and dynamic balance. We have internal senses which report hunger, thirst, and the like. And finally we have senses in the muscles and about the joints which inform us about the contractural states of the muscles and the relative positions of the parts of the body. Inverse feedback circuits involving these receptors enable us to correct our movements while they are in progress, and with added input from other senses to do such things as hitting a pitched ball with a bat whose swing started before the ball had gone far enough from the pitcher's hand to provide any accurate cue concerning its ultimate course.

Another early topic is psychophysiology, the study of the relationships between anatomical structure and physiological functions, and behavior. We learn that in the brain there are primary sensory and motor areas, semi-localized perceptual areas, but no known localized areas (as the phrenologists would have us believe) corresponding to abilities and traits of character and personality. Lashley discovered years ago by operating on the brains of rats that loss of a well-learned maze habit was proportional to the amount of tissue removed and almost independent of the area from which it was removed.

There are 10 billion nerve cells in the brain, and each of them connects to a dozen or more others on each end. Thus although the typical neural message travels over 50 to 100 parallel paths, the number of effectively distinct possible neural patterns of conduction is inconveivably large: whole orders of magnitude larger than, say, the the number of elementary particles in the visible universe. All of which is to say merely that if you want to be a mechanist you can: the human brain as a multiple-relay computer is complex enough to accout for the handling of 100 bits of information input per second for a lifetime, and we know the information input is not greater than this. Creative imagination could be some slight distortion of one-thousandth of one per cent of the input.

A third early topic is psychophysics: the quantitative relations between stimulus and sensation. The major landmarks here are Weber's Law (at any stimulus magnitude, discrimination between two nearby stimuli is proportional to the increment divided by the absolute magnitude), and Fechner's generalization (sensation intensity is proportional to the logarithm of the stimulus intensity). A familiar example is the decibel scale, whose arbitrary unit is very nearly the just-noticeable-difference in sound intensity, and whose arbitrary zero (when this is used) is one such unit below the absolute sound-intensity threshold: the faintest sound that can be heard at all. For most sense modalities these laws are almost correct over the middle ranges, but become incorrect near the two extremes.

The main theoretical topic of normal human and animal psychology is learning. There are several major competing theories. Among these we have the stimulus-response contiguity theory and the stimulus-response reinforcement theory. The first of these may be summed up in the sentence, "In any situation, what is done is what is learned, and in any later situation including elements of the first, the previous act is likely to be repeated." For example: Mary, four years old, has acquired the habit of rushing into the house, shedding her coat on the hall floor as she passes through it. Mother insists every time that she pick it up and hang it in the closet. Later she rushes in and sheds her coat on the hall floor, but as soon as she sees Mother she turns back, picks it up, and hangs it in the closet. What is done is what is learned. On advice of a psychologist, Mother now makes Mary put her coat back on, go clear out of the house, rush back in, take it off, and hang it in the closet. Mother takes care to be out of sight of the hall when Mary comes in the second time. This works. What is done, and more particularly what is last done, is what is learned.

The reinforcement or reward theory holds that all activity results from basic motives, and that any act tends to be learned whenever its occurrence satisfies a need and thus reduces some aspect of the motivational level. In human learning there is generally assumed to be a success motive, and it is well known that learning is more rapid, accurate, and permanent when the learner knows about every success as soon as it occurs. With animals, the psychologist usually plays safe and feeds them after every success!

In one experiment at the University of Tennessee, designed to the test contiguity theory *versus* the reinforcement theory, rats were given access to unlimited food for exactly one hour at the same time every day for a month. Then one group went without food for a day and a half, another for two days, a third for two and a half days, and a fourth for three days. At the conclusion of the fast, each group was given unlimited access to food for exactly one hour. What happened? During the hour immediately following the fast, the animals which had fasted longest ate *least!* The trend was uniform and highly significant. The more *different* the internal cues were from normal, in the presence of food, the less the animals ate, even though the difference was hunger. A more recent experiment at Stanford, however, gave different results, so this question is not yet settled.

One definition of a stressful situation is that it is *any* situation sufficiently different from the usual or normal. In a study at McGill University, human subjects were placed in a dark, sound-shielded room, lying on a couch, wearing translucent goggles, with cardboard cylinders over their arms and hands. They were given food and water at regular intervals to prevent any undue heightening of internal stimulation; the object of the procedure was to reduce external stimulation drastically. After confinement in this situation for a day or more, the subjects' efficiency in solving anagrams and problems in mental arithmetic was markedly impaired, and some of them experienced vivid visual hallucinations of a type not usually found in normal persons. Later studies may attempt to develop thinking habits which can replace external stimulation in preserving mental efficiency under these conditions. These studies may account for the effectiveness of certain "brainwashing" techniques which depend essentially on reducing drastically all external stimulation *except* that used to present a propaganda line. It may also show that when criminals in solitary confinement resort to door-shaking, screaming, hopping up and down, etc., their actions can be explained in terms of self-produced external stimulation to reduce the stress, just as well as in terms of infantile regression and similar concepts much further removed from direct behavioral definability.

Other topics within the realm of normal human and animal psychology include motivation and emotion, memory (including retention, recall, and recognition), reaction time, reasoning, imagination, communication, applied learning (including practice and skill, methods of effective study, etc.), and transfer of training. Most of these we must past over, but I should like to note a few points about the last.

Transfer of training occurs whenever practice of one task facilitates or interferes with the learning of another. The key is similarity of elements—of materials or methods of work or attitudes—and in particular, identity of some underlying principle. In a now classic experiment, one group of high school boys were taught refraction while another was not. Both groups then practiced throwing darts at a horizontal target three inches under the surface of a pool of water. The groups were about equal in learning-rate and final performance. Then the target was moved down so that it was six inches under the surface. Now the group that had been taught refraction adapted quickly; the other group experienced interference and learned the second task more slowly than they had the first.

In another study, an intelligence test consisting of equal numbers of verbal, arithmetical and spatial-relations problems was given to several thousand high school students at the beginning and again at the end of the school year. Students taking three subjects the same and the fourth different were compared for differences in average gain. All such differential gains were small compared to the absolute gains due to practice effect and to nine months' mental growth and general learning. The academic subjects seemed at first to possess such advantages as appeared, but when every school subject was rated on the basis of the similarity of its content to the specific content of the test, the relation between the similarity ratings and the observed differential gains was almost perfect. The academic subjects produced greater gains only because the test content resembled them more than it did the non-academic subjects.

In still other studies it has been shown that memorizing prose improves the ability to memorize other prose more than it improves the ability to memorize poetry, and *vice versa;* and memorizing *either* connected prose or poetry in large quantities has practically no effect on the ability to memorize names and faces presented pictorially. The former involve serial learning; the latter paired-associate learning, and aside from very general principles, the learning methods are different. But teaching the principles of efficient memorizing, with adaptations and very short practice exercises with several different kinds of materials and learning processes, improves all varieties of memorizing to which the principles properly apply.

The conclusion is one which teachers and educators have resisted for at least a generation. There is no such thing as *formal* mental discipline. The process whereby exercise of any type strengthens the muscles used has no parallel in the central nervous system. The facts and principles of a school or college subject are valuable only insofar as they are likely to be used directly or almost directly at some later date. If the object of education is merely to improve *generally* the memories, reasoning abilities, imaginations, observational acuities, and other so-called "mental faculties" of students, the only subjects which *have* any value are applied psychology of learning, logic, propaganda analysis, and the like. All other departments can close up immediately. As to applied psychology of learning, everything we really know can be taught in one one-quarter course, so we could close up too after just one quarter!

Let me hasten to add that most school subjects *do* include facts and principles that have value in and of themselves. The principles should be emphasized, and their applications illustrated in a wide variety of fields to facilitate transfer. Facts also must never be sold short. Reasoning is a *process,* and facts are the materials on which it operates. People reason best in those fields wherein they know the most facts. Imagination and appreciation are also processes which operate only upon factual data. We need to learn the facts which make them effective, too.

There are a few school subjects, however, whose values can really be questioned. My own pet peeve is Euclidian geometry. Its subject-matter is virtually unique and non-transferable. It is of course a *tour de force* in the deductive method. But dedutive logic itself can be studied directly, with application to a wide variety of fields to insure its transfer value. Descartes, on finishing his "Analytic Geometry," is said to have remarked that at long last Euclid's "Elements" was out-dated. We have not effectively caught up with him in 300 years. How much of Euclid do we really need, even for analytic geometry, trigonomentry, and elementary calculus? Three or four theorems; half a dozen at most. So why not reduce geometry from a year course to one short unit, and devote the time thus saved to *really* teaching algerbra, whose applications in modern life are legion, and which is basic to *all* further mathematics? Or why not teach probability and elementary statistics in high school? They are the mathematical foundation of almost all of social science that is really science.

III

So much for normal human and animal psychology. Developmental psychology, social psychology, and abnormal psychology, we must skip over without even mentioning their major topics. But I can't resist a few remarks on differential psychology.

First, the *jingle fallacy*. A group is covered by one name, so its members must be essentially similar. Say "*the* college student"—what are his characteristics? Men, women, freshmen, sophomores, juniors, seniors, graduate students, full-time, part-time, extension students, day students and those who live on the campus, students at Princeton and at Podunk Junior College, native-born, foreign-born, city reared, rural—who is "*the* college student"? Even in test-intelligence, college students are well over half as variable as the whole young adult population. "*The* farmer," "*the* Negro," "*the* laborer," "*the* Jew," "*the* professional man," "*the* manager," "*the* skilled craftsman," "*the* white-collar worker," "*the* urbanite"—take representative samples of any two of these groups and measure them on *any* mental or personality or character trait. The variability within each group will far outweigh the average difference. Whichever group is higher, 30 or 40 per cent of the other group will exceed its average. Sum all this up in one of the surest generalizations psychology can offer: group differences are always small in comparison to the variability within each group on any measurable trait not directly related to the trait defining the difference between the groups.

Consider the term "intelligence." One word, one concept. Is there only one concept, or is this another case of the jingle fallacy? "Intelligence": hereditary *potentiality* for intellectual performance. Let it interact with the physical—perhaps better the physiological—environment. The result is maturation or structural growth. Then we have "intelligence": the *capacity* for intellectual performance. This capacity is mainly a matter of the structure of the brain. Let it *learn,* by interaction with the cultural enviroment. This includes elements of the physical environment as well as the social environment, and for our present purposes, in fact, the term "cultural environment" is defined as all elements of the total environment which influence learning. The result of this learning is "intelligence": the *ability* to solve intellectual or symbolic problems. An intelligence test is a standardized set of such problems. Let our subject sit down, and give him the test. Call it "intelligence": *performance* in the test situation. Evaluate this performance numerically, by counting right answers, giving half credit for partially right answers, etc. The result is "intelligence": the intelligence-test score. Compare this with the scores of John Doe, the average American, at various ages. Find the precise age at which John Doe would have made the same score. This is "intelligence": the mental age of our subject. Divide our subject's mental age by his actual age on the test date. This is "intelligence": the IQ.

If our subject is over 12 years old, the last steps must be modified. Mental growth is almost linear from birth to 12, and the IQ, in consequence, is an almost correct statement of the subject's performance as a percentage of average performance. But from 12 to about 22, mental growth slows down, and after about 22 it ceases altogether. So for any score above the 12-year average, the mental age is the age at which John Doe *would* have made that score if by some miracle his mental growth could have continued unabated after age 12. In this case, he would have reached by age 15 the final score which he actually reaches at about age 22: at mental maturity. This is what we mean when we say that the mental age of the average adult is 15, and why we divide the mental age by 15 to find the IQ of an adult.

Now let's consider a whole group of subjects or examinees, and reverse the sequence. We give them our intelligence test, and valuate the products of their performance. *If* our evaluations are accurate, the IQ differences in our group are proportional to real differences in test performance *at the given test session*. *If* (and only if) we really found John Doe himself, the average American, when we standardized the test, each IQ is a valid percentage comparison of the subject's performances with John's. *If* (and only if), in addition, the level of motivation at our own test session was the same as that at the standardization sessions, each IQ is a valid percentage comparison of the subject's test *ability* with that of John Doe. *If* (and only if), in addition, all subjects have had equivalent (if not identical) cultural environments throughout their lives, IQ differences are proportional to differences in mental *capacity*. And *if* (and only if), in addition, all subjects have had equivalent physiological enviroments, IQ differences are proportional to differences in hereditary intellectual potentiality.

Now we know that the absolute answer to every one of these *ifs* is " 'taint so." The real questions are those of degree: to what approximation are these criteria met in practice? Hundreds of studies have been designed to answer the question of the relative contributions of heredity, environment, and motivation to differences in test-intelligence. Every one of these studies has "bugs"—necessarily. Nevertheless, the questions can be answered to a fair approximation. In the usual test situation, and for most subjects, motivational differences affect score differences only slightly if there is any substantial motivation for all subjects. Fatigue, loss of sleep, poor testing conditions, and the like affect them still less. The average college student can still beat John Doe after staying awake for 72 hours.

As to heredity and environment, IQ differences over the whole population are quite probably due not more than ⅔ nor less than ½ to differences in heredity. A valid IQ cannot as yet be boosted more than 10 to at most 15 points by moving a child from an average environment to one regarded as intellectually superior. But environments so intellectually defective still exist in America, that movement from them to an average environment may increase the IQ by 20 points, and in rare cases even more.

Now let's consider another fallacy: *the jangle fallacy.* Two words, hence two distinct concepts. Take "intelligence" and "school achievement." Ah yes! Intelligence is capacity for school achievement, and school achievement itself is intelligence *plus* quality of teaching, attitude of the child toward school, study habits, and the like. Or *is* it? *Which* "intelligence" are we talking about? And *which* corresponding "achievement"? Can we divide a child's EQ—his educational quotient derived from a school achievement test – by his IQ, and thereby get another quotient reflecting his motivation, his attitude toward things scholastic, his study habits, and how well he reacts to the teacher? Unfortunately the answer is NO, though still more unfortunately, teachers not well trained in mental measurement are doing this fairly frequently. Let's go back a minute. The questions of an intelligence test *try* to be representative of all types of problems we can properly call intellectual. The inference of capacity is based on the assumption of a uniform *general* cultural-intellectual environment. The achievement test, no more and no less than the intelligence test, is an evaluation of a sample of performance. But where the intelligence test ranges over all types of intellectual problems, the school achievement test sticks to those types which are taught in school. The inference from performance to capacity is the same. Achievement test performance differences reflect differences in capacity for achievement to the extent that the educational environments of pupils are uniform. But the function of the school as a social institution is precisely to equalize—mainly by maximizing — the educational environments of all pupils. The school environment in America is certainly more uniform than is the *general* cultural-intellectual environment. So over the more limited range of abilities which it measures, the school achievement test comes closer to measuring structural capacity than does the general intelligence test! All of this, however, is unimportant in the face of empirical data. If school achievement is measured by a good standardized test of reading, arithmetic, spelling, language usage, history, geography, and elementary science, while intelligence is measured by the Stanford-Binet Scale, the functions or abilities measured by the two tests are 90 per cent the same. So don't be fooled by the jangle fallacy as regards the terms, "intelligence" and "achievement." If these terms mean operationally *test*-intelligence and *test*-achivement, then for Johnny or Mary or almost any child you name, the difference will be smaller than the combined errors of measurement of the two test.

Now let's return to a previous point—desirable traits are positively correlated — and rub it in a bit. The largest psychological study ever undertaken started in the early 20's with the identification of about 1500 children in California, all with Stanford-Binet IQ's above 140, and hence in the top one per cent of the general population in this respect. There was no other criterion for inclusion in the group. These children were then given all manner of other tests. Complete case histories were prepared. Follow-up tests have been given at 10-year intervals for 30 years, and the case-histories have been brought up to date at each 10-year interval. What are the characteristics of this group selected on Stanford-Binet IQ alone?

They were and are a little taller and heavier than the average American. As babies, they walked two weeks earlier and talked a month earlier. In elementary school, their real achievements were two years ahead of their grade locations despite considerable "skipping." In high school they maintained this superiority, and at the same time held ten times as many elective offices as their numerical proportions would indicate they should have held. Unlike the average adult, their test-intelligences continued to increase after mental maturity in the early or middle 20's; they selected adult environments and occupations which continued to stimulate problem-solving ability. Ninety per cent entered college, 70 per cent graduated, and 47 per cent remained for graduate work. Seventy-eight took the PhD and 48, the MD. Forty per cent of the men and 20 per cent of the women who went to college earned more than half their college expenses, a total of $670,000 in addition to scholarships and fellowships amounting to $350,000. The investigator, Dr. L. M. Terman of Stanford University has been able to maintain effective follow-up for 30 years on 98 per cent of the original group: the most astounding instance of cooperation in the history of the social sciences. They have been conspicuously absent from prisons and mental hospitals, they have not died in anything like the numbers predicted by life tables, they have had fewer illnesses than average, and the number of alcoholics among them is subnormal.

Considering only the 800 men, averaging age 40 in 1950, they had published 67 books, 1400 technical papers, 200 short stories, novels, and plays, and 236 miscellaneous articles. They also owned 150 patents, and 47 were listed in the 1949 edition of *American Men of Science.* These figures are about 20 times the average for American men in general.

These findings were corroborated by an intensive biographical study of the childhood traits of 300 authentic geniuses who lived between 1500 and 1900, with estimates of their IQ's based on specific accomplishments at known early ages. For example:

Day set on Cambria's hills supreme
And Menia on thy silver stream
The star of day had reached the West.
Now in the main it sunk to rest.
Shone great Eleindyn's castle tall;
Shone every battery, every hall;
Shone all fair Mona's verdant plain;
But cheifly shone the foaming main.

At what age *could* an *average* child write verse of this calibre? Thomas McCauley wrote this one month before he was seven years old. How high an IQ do we have to postulate for McCauley to explain such performance at such an age? This is only one example of the data used in estimating McCauley's IQ. If you have a favorite genius who lived between 1500 and 1900, there is a fair chance you can find an estimate of his IQ, and the evidence on which it is based, in Cox's book, *The Early Mental Traits of 300 Geniuses,* Volume II of the series, *Genetic Studies of Genius,* published by the Stanford University Press.

A topic which has fascinated me for some time is that of the absolute upper limit of human intelligence—the greatest intellectual performance of which a human mind, at a given level of development, is capable. I have not read all the incidents on which the IQ estimates for the 300 geniuses were based, but I have read quite a few of them, and I doubt if any is comparable to that of a boy who may now be living in America. Let me conclude by telling the incident as if it were a fairy tale, though it is actually cold fact.

"Once upon a time there was a little boy who lived in New York City. He was a smart little boy, though his parents did not "force" his intellectual development in any way. His Stanford-Binet IQ, in fact, was 196, but that isn't very important, and the examiner reported that it was probably an underestimate. Now this little boy was interested in the relations between the days of the week and the dates. He learnd to use the calendar, and noticed that a given date on last year's calendar came on a different day of the week from the same date on this year's calendar. He pestered his father to tell him about the system by which calendars are constructed. So his father told him about leap years, and the infrequent occasions on which a year that ought to be a leap year isn't. He thought this all over and decided that the calendar is a pretty stupid device. What we need, he decided, was a *system* that would make printed calendars unnecessary. So he figured out a system. After doing so he could tell, in a few seconds, the day of the week on which *any* date, past, present or future, must fall. And that is the story.

"Oh no, I forgot. When he figured out the principles and structure of the perpetual calendar he was just 3-1/2 years old."

HISTORY OF SCIENCE INSTITUTE

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Lynch, Sister M. Ellen Dolores, C.S.C., Assistant Professor of Chemistry, Dunbarton College of Holy Cross, Washington, D. C. (Chem.)

McClurkin, Dr. J. I., Professor and Head of Biology Department, Randolph-Macon College, Ashland, Virginia (Biol.)

McKnight, Dr. John L., Associate Professor of Physics, College of William and Mary, Williamsburg, Virginia (Phys.)

McMullen, Mr. Roy Gene, Instructor of Physics, Texas College of Arts and Industries, Kingsville, Texas (Phys.)

Outten, Dr. L. M., Professor and Acting Head of Biology Department, Mars Hill College, Mars Hill, N. C. (Biol.)

Owen, Dr. Oliver S., Assistant Professor of Biology, Mankato State College, Mankato, Minnesota (Biol.)

Phillips, Dr. J. P., Professor of Chemistry, University of Louisville, Louisville, Kentucky (Phys.)

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Rappenecker, Dr. Caspar, Head, Department of Geology, University of Florida, Gainesville, Florida (Geol.)

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Spooner, Prof. James D., Professor of Biology, South Georgia College, Douglas, Gerogia (Biol.)

Steinbeck, Prof. Paul W., Assistant Professor of Engineering, University of Illinois, Urbana, Illinois (Phys.)

Strickler, Dr. Thomas D., Associate Professor of Science, Berea College, Berea, Kentucky (Chem.)

Thomas, Dr. Dan A., Professor of Physics, Rollins College, Winter Park, Florida (Phys.)

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