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Are Scientists Different?

The question is raised by the current friction between scientists and government officials. The answer is sought in the differences between scientists and nonscientists in a group studied since 1921

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Of the many reasons why we need to know more about scientists than we do, two are particularly important at this time. One is the current shortage of scientists, especially in the physical sciences and engineering. This shortage exists despite the rapid rise in the numbers trained in recent decades, and the ratio of supply to demand promises to become less rather than more favorable. To develop more fully the scientific resources of our population will require the identification of potential scientists at a reasonably early age, and this in turn calls for more specific information than we have about the "earmarks" of scientific talents.

The second reason we need more information about scientists is the tension that is building up between them and important segments of the general public. The scientist is looked upon by many as an object of suspicion, and he in turn is irked by the distrust he senses and by the restrictions government work imposes upon him.

Suspicion of scientists has a long history. In the Middle Ages their works were easily confused with black magic and sorcery. Later they came to be looked upon as enemies of the Church; some were tried and condemned for heresy. Even as recently as 75 years ago a scientist (especially a biologist) who proclaimed a new theory was likely to be met with angry vituperation. By 1900 scientists had won the freedom to explore and to publish in all but the most backward areas of the western world. They were free to work at problems of their own choosing and to discuss them freely with one another. Their research was inadequately supported, but they were beholden to no government.

The fission of the atom changed all that. Scientists suddenly found themselves strait-jacketed by security regulations which limited severely their contacts with fellow scientists, their freedom to publish, their right to work on specific problems, even their right to travel abroad. Although these limitations were often carried to unnecessary lengths, during the war the great majority of scientists patriotically acquiesced in them. It is hardly surprising that now, in the current climate of suspicion and fear, more and more of them are reluctant to work for a government which does not protect them from harassment and unjust accusations.

The scientist

It is not our purpose to apportion blame for the misunderstandings but rather to try to identify some of the human factors that contribute to them. If scientists are frequently misunderstood by nonscientists, the converse also is true, and information capable of throwing any light on the differing attitudes of the two groups ought to be welcomed.

For the double purpose, then, of trying to learn how to detect specific scientific talents and of understanding the differences between scientists and nonscientists, we undertook, with financing from the Office of Naval Research, a comparative study of the men in the well-known group of gifted persons whose careers we have followed for more than 30 years.

Our entire group consists of 800 males and 600 females who were selected in 1921 when they were students in the

top 1 per cent of the school population in general intelligence, as measured by mental tests. The careers and development of all these persons have been followed almost continuously, through questionnaires mailed to them from time to time and by four detailed field studies (in 1921, 1927, 1939 and 1950). The group is the only one of its kind that has been studied so intensively over so long a period.

For the comparative study of scientists and nonscientists we confined ourselves to the 800 men, because only a few of the women have pursued scientific careers. We classified the men into seven groups:

Physical Science Research—workers in basic physical science or engineering research. This group of 51 includes 18 engineers, 17 chemists, 9 physicists and 7 in four other fields.

Engineers—practicing engineers and those who have done some applied research. The group totals 104.

Medical-Biological—workers in biological research or in medicine. Of the 61 members of this group, 26 are researchers and 35 practicing physicians.

Physical or Biological Science, Nonresearch—men who majored in a science as undergraduates but have mainly gone into other fields of work. Of the 68 in the group, 11 are science teachers.

Social Science—men who majored in a social science. Most of these persons are in business occupations. Those who became research social scientists, mostly psychologists, were omitted from our comparisons because they seemed not to belong with the business group and were too few in number (19) for statistical treatment as a separate group. The SS group totals 149.

Lawyers—a group totaling 83.

Humanities—men who majored in a field of the humanities in college. They have gone into a great variety of occupations, with teaching and business predominating. The group totals 95.

To uncover differences among these groups, information about the individuals under several hundred headings was analyzed by means of IBM cards and a sorting machine. The method used in assessing the differences for a given variable was the chi square technique. Of the many variables on which these groups were compared, 108 yielded significant differences. We shall consider here only those in three categories: (1) scientific interests evidenced, (2) interests in business occupations, (3) social traits and social adjustment.

Let us see first how the groups compare in scientific interests. For rough purposes of comparison we can class as scientists the workers in physical sciences, the engineers, the workers in biology and medicine and the men who majored in science in college; the nonscientists include the lawyers, the majors in the humanities and the majors in social science. The reader should bear in

	VARIABLE TESTED	PHYSICAL SCIENCES (RESEARCH)		ENGINEERING		MEDICAL-BIOLOGICAL SCIENCES		PHYSICAL-BIOLOGICAL SCIENCES (NON-RESEARCH)		SOCIAL SCIENCES		LAW		HUMANITIES		TOTAL	
		NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT
1922	A SCIENCE NAMED AS SUITABLE OCCUPATION FOR THE CHILD BY THE PARENT	27	59	49	59	25	40	24	58	50	14	40	10	46	20	261	34
1922	A SCIENCE NAMED AS SUITABLE OCCUPATION FOR THE CHILD BY THE TEACHER	12	67	39	49	16	56	21	43	43	23	36	14	32	25	199	34
1922	CHILD NAMED A SCIENCE AS HIS OCCUPATIONAL PREFERENCE	34	74	76	62	45	58	46	52	109	31	67	21	64	28	441	43
1922	CHILD NAMED ENGINEERING AS HIS OCCUPATIONAL PREFERENCE	34	38	76	58	45	20	46	33	109	13	67	9	64	14	441	25
1922	HIGH ON MECHANICAL INGENUITY: COMPOSITE OF PARENT AND TEACHER RATINGS	45	47	94	63	50	34	64	52	137	28	77	31	82	33	549	40
1940	INTEREST IN SCIENCE ABOVE AVERAGE ON SELF-RATING	45	98	89	88	53	96	58	86	130	36	73	32	83	49	531	63
1940	INTEREST IN MECHANICS ABOVE AVERAGE ON SELF-RATING	45	64	89	82	53	34	58	60	130	24	73	21	83	30	531	43
1940	SCORE OF B+ OR BETTER FOR CHEMIST ON VOCATIONAL INTEREST TEST	44	98	82	83	44	73	55	64	116	25	61	28	78	41	480	53
1940	SCORE OF B OR BETTER FOR ENGINEERING ON VOCATIONAL INTEREST TEST	44	95	82	87	44	64	55	75	116	32	61	31	78	33	480	55
1940	SCORE OF B OR BETTER FOR MATH-SCIENCE TEACHER ON VOCATIONAL INTEREST TEST	44	77	82	78	44	66	55	64	116	40	61	41	78	46	480	56
1940	SCORE OF B OR BETTER FOR PHYSICIAN ON VOCATIONAL INTEREST TEST	44	75	82	49	44	86	55	62	116	24	61	38	78	62	480	51

SCIENTIFIC INTERESTS of men in the group studied by Terman are correlated with their present occupations (*upper right*). Engineering is combined with the other sciences in the first three items of the table and is also treated separately as the fourth item.

mind that the three categories based on majors in college (in science, social science or humanities) are heterogeneous groups embracing a wide variety of occupations in each case.

Eleven items of information relating to scientific interests or ability yielded highly reliable differences between scientists and nonscientists. The first five of these items represent the early interests and talents of the subjects as youngsters; the information was obtained in 1922, when the average age of the subjects was close to 11 years. The remaining six items report their interests 18 years later in 1940, when they were grown men and launched on their careers. The ratings of the groups on these 11 items, in terms of the percentage of persons who exhibited interest or talent on each variable, are summarized in the table on the opposite page.

Even as children those who later fell in the four science groups showed a far higher tendency to aptitude in science than those in the three nonscience groups. This is in accord with studies of the early mental development of eminent scientists, which have shown that often their bent is foreshadowed by their interests and preoccupations in childhood. Apparently the same is true of scientists whose achievement to mid-life is much less distinguished. It is especially significant that aptitude for science is so often detected by parents and teachers with little or no professional training in psychology, and even more often by the children themselves.

It might be supposed that the interests of our subjects in 1940, when their average age was about 30, would not reflect natural bents so much as the effects of educational concentration and vocational experience. That such experience is far from being the sole factor in shaping interest patterns is indicated by the fact that the intergroup differences in 1940 were in most cases very similar to those in 1922. Indeed, scores on the Strong vocational interest test are surprisingly constant. Of 250 men who took the Strong test as college freshmen and again 20 years later, few showed appreciable changes in their scores, and such changes as occurred bore little relation to the kind or amount of educational or vocational experience in the interim.

It can be seen in the table that the groups with the most consistently low percentages on scientific interests are the social science majors (mainly businessmen) and the lawyers. The humanities group is fairly high on one item but is relatively low on all the others. At the opposite extreme are the physical scientists, engineers and science majors, who are high to very high on at least 10 of the 11 items. The contrast between the four groups of scientists and the three groups of nonscientists in this gifted population is much the same for the childhood data as for the data obtained nearly 18 years later.

When we come to interest in business

VARIABLE TESTED	PHYSICAL SCIENCES (RESEARCH)		ENGINEERING		MEDICAL-BIOLOGICAL SCIENCES		PHYSICAL-BIOLOGICAL SCIENCES (NON-RESEARCH)		SOCIAL SCIENCES		LAW		HUMANITIES		TOTAL	
	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT
SCORE OF C+ OR BETTER FOR BANKER	44	25	82	29	44	23	55	42	116	67	61	59	78	35	480	44
SCORE OF B− OR BETTER FOR PURCHASING AGENT	44	36	82	57	44	20	55	44	116	67	61	44	78	24	480	46
SCORE OF B− OR BETTER FOR CERTIFIED PUBLIC ACCOUNTANT	44	70	82	44	44	48	55	47	116	71	61	80	78	50	480	59
SCORE OF B− OR BETTER FOR ACCOUNTANT	44	43	82	54	44	25	55	47	116	61	61	46	78	27	480	46
SCORE OF B− OR BETTER FOR OFFICE WORKER	44	30	82	49	44	39	55	49	116	74	61	46	78	37	480	50
SCORE OF B OR BETTER FOR PRODUCTION MANAGER	44	68	82	91	44	55	55	71	116	51	61	30	78	26	480	55
SCORE OF C+ OR BETTER FOR SALES MANAGER	44	27	82	48	44	32	55	51	116	84	61	70	78	53	480	57
SCORE OF C+ OR BETTER FOR LIFE INSURANCE SALESMAN	44	16	82	22	44	36	55	35	116	75	61	62	78	54	480	47
SCORE OF B OR BETTER FOR LAWYER	44	36	82	18	44	48	55	40	116	65	61	89	78	72	480	54

OCCUPATIONAL INTERESTS in business of men in the same group were graded in 1940 by the Strong vocational interest test. This further indicates that the differences between the groups of scientists and nonscientists changed very little from 1922 to 1940.

occupations, the picture is reversed, as we might expect [*see table on preceding page*]. The nonscientist groups score highest on interest in the nine business occupations listed (the law is included among them because so much legal work is concerned with or similar to business). In contrast, the three groups of workers in science score low to very low on interest in business, and the science majors hold an intermediate position; it will be recalled that most of the latter went into fields other than science. In the exceptional cases where a science group showed high interest in a business occupation, the reason is fairly obvious. For example, the occupation of certified public accountant would be expected to have some appeal to a physical scientist, who has an interest in numbers. Similarly the interest of engineers in the jobs of purchasing agent and production manager reflects their preoccupation with "things," while their low score on interest in the occupation of life insurance salesman probably reflects ineffectiveness in person-to-person relationships.

The marked contrast between the groups of scientific workers on the one hand and the lawyer and social science majors on the other is most significant. For it is physical scientists, engineers and biologists who do most of the Federal Government's secret research, and do it under rules that are laid down by a Congress composed mainly of lawyers and businessmen. It would be an oversimplification, however, to assume that the difficulties of these contrasting groups in trying to understand each other are fully explained by their differing interests *per se*. Rather the differences in interest are symptomatic of underlying differences in personality.

This brings us to the group differences in social traits. They were expressed in terms of 15 items relating to sociabil-

VARIABLE TESTED	PHYSICAL SCIENCES (RESEARCH)		ENGINEERING		MEDICAL-BIOLOGICAL SCIENCES		PHYSICAL-BIOLOGICAL SCIENCES (NON-RESEARCH)		SOCIAL SCIENCES		LAW		HUMANITIES		TOTAL	
	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT	NUMBER	PER CENT
HIGH COMPOSITE RATING BY PARENT AND TEACHER ON FIVE SOCIAL TRAITS—1922	45	46	96	44	50	62	64	44	138	59	78	67	83	49	554	53
HIGH SOCIABILITY SCORE ON PLAYS AND GAMES TEST—1922	17	53	43	56	25	76	26	81	78	74	45	84	41	71	275	72
IN HIGH SCHOOL ENGAGED IN SEVERAL TO MANY ACTIVITIES	43	47	91	43	58	53	61	52	134	60	80	67	83	69	550	57
MORE THAN AVERAGE INTEREST IN SOCIAL LIFE—1940	45	24	89	12	53	40	58	31	130	38	73	33	83	23	531	29
MORE THAN AVERAGE INTEREST IN POLITICS—1940	45	42	89	39	53	43	58	47	130	57	73	66	83	43	531	49
ALWAYS VOTED IN LOCAL ELECTIONS—1950	45	24	95	52	56	46	60	44	132	52	74	59	82	54	544	50
SCORE OF C+ OR BETTER FOR SCHOOL SUPERINTENDENT ON VOCATIONAL INTEREST TEST—1940	44	52	82	27	44	43	55	44	116	53	61	74	78	68	480	52
SCORE OF B− OR BETTER FOR SOCIAL SCIENCE TEACHER ON VOCATIONAL INTEREST TEST—1940	44	30	82	23	44	45	55	33	116	65	61	61	78	54	480	47
BELONGS TO TWO OR MORE CLUBS OR ORGANIZATIONS—1950	44	77	93	59	56	89	59	68	126	62	74	88	77	66	529	71
ENGAGES IN ONE OR MORE SERVICE ACTIVITIES—1950	44	23	93	41	56	46	59	49	126	48	74	58	77	42	529	45
MORE THAN MODERATE INTEREST IN COMPETITIVE SPORTS, AGES 12-20—1951	37	27	79	44	46	30	45	42	111	60	64	55	65	38	447	46
ABOVE AVERAGE IN CONFORMITY TO AUTHORITY AND CONVENTIONS—1951	36	47	75	41	45	47	42	55	109	49	62	74	63	52	432	52
MORE THAN MODERATE INTEREST IN SOCIAL SUCCESS, AGE 12-20—1951	37	14	78	28	46	37	45	27	109	52	64	33	65	37	544	36
IN CHILDHOOD AND YOUTH FELT DIFFERENT FROM OTHERS—1951	37	68	82	52	49	67	50	56	116	46	66	52	69	77	467	57
GOOD SOCIAL ADJUSTMENT HAS FURTHERED LIFE ACCOMPLISHMENT—1951	37	27	78	47	46	46	44	45	108	58	62	47	62	56	437	49

SOCIAL TRAITS of the various groups are reflected by items of information gathered by the studies of 1921-22, 1939-40 and 1950-51. The subjects were 800 men who were selected in 1921 from the top 1 per cent of the school population in general intelligence.

ity, social adjustment, interest in people and social insight [*see table on opposite page*]. The sociability score was derived from the subjects' preferences, as children, between social play and less social or solitary activities. Some items in the table are based on self-ratings; interest in people was measured by the subjects' reactions to two occupations calling for such interest. On the next to last item of the table a high score signifies a tendency to poorer social adjustment.

The analysis leaves no doubt that nonscientists tend to score higher than scientists in social relations. The lawyers and social science majors usually rated highest; the physical science researchers, engineers and science majors generally rated lowest; and the medical-biological group and humanities majors were in between. The groups showed a consistency of scores which is remarkable when one considers the wide range of attributes, indexes and times represented by the 15 items.

Nevertheless one must guard against overgeneralization. Actually all degrees of social adjustment and social understanding are found within each of the seven groups. Everyone knows that some scientists are extremely adept in social perception and in social relations—sufficiently adept to become deans, college presidents or other administrative officials. Yet it is true that the bulk of scientific research is carried on by devotees of science for whom research is their life and social relations are comparatively unimportant.

The life histories of the physical scientists and engineers among our gifted subjects bear interesting similarities to those of the 22 eminent physicists examined by Anne Roe [see "A Psychologist Examines 64 Eminent Scientists," by Anne Roe; SCIENTIFIC AMERICAN, November, 1952]. Her physicists and our two groups exhibited the same early interest in mechanics, mathematics and science. The resemblance also holds for social traits: as a group her physicists tended to be shy, lonely, slow in social development, indifferent to close personal relationships, group activities or politics. There are also some resemblances between Roe's 20 eminent biologists and our medical-biological group: most of these individuals showed little interest in mechanics or mathematics, either in childhood or later. However, our physicians and biologists displayed more social interests than our physicists, chemists and engineers, whereas Roe described her biologists as socially very similar to her physicists. Her 22 professional social scientists are not comparable with the businessmen of our SS (social science major) group.

The nonscientist?

Are the social traits that characterize so many scientists to be regarded as defects of personality bordering on the abnormal? The answer is no. Mental or emotional breakdowns were no more common among scientists than among nonscientists in our gifted sample of the population. It appears that departures from the average personality pattern, upward or downward, may be decidedly favorable to the making of a scientist; for example, a below-average interest in social relations and a heavy concentration of interest on the objective world.

At any rate, in our gifted group the physical scientists and engineers are at the opposite pole from the businessmen and lawyers in abilities, in occupational interests and in social behavior. These basic personality differences may well account for much of the current friction between scientists and the government officials who are responsible for their security clearances and for the restrictions imposed upon them.