

A Historical Chronology of the Plight of African Americans Gaining Recognition in Engineering and Technology

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Africans and African Americans have contributed significantly to the evolution of many of the engineering technologies that we can identify with today in areas such as manufacturing, construction, electronics, design graphics, transportation. Due to past history, many African Americans' inventions have been obscured from the public eye. Further, the inventions of African slaves in America automatically belonged to their owners. It wasn't until after slavery that African Americans were given credit for their inventions when they were patented. But even when some patents were sold to Whites, African Americans did not receive proper credit. Therefore, it is virtually impossible to show all of the significant contributions of African Americans in our society.

Science is a pervasive and dominating force in American society. It is a primary source of the understanding of the worlds—physical, biological, behavioral, and social—in which we live; directly or indirectly, it shapes the boundaries and directions of all phases of American life. As a major institutional component of our society, the scientific community inevitably reflects the values of American society at large in its own social structures, beliefs, and attitudes. And, like American society in general, American science reflects the dominance of Whites (Bechtel, 1989). The Black scientist in America is historically an anomaly and currently a statistical rarity. In 1984 Blacks accounted for only 2.3%, or 90,500, of the 3,995,000 employed scientists and engineers (Kusmer, 1991) Even now, in the 21st century, Blacks were 11.3% of the labor force, but only 4.2% of natural scientists, 7.6% of math and computer scientists, and 4.6% of engineers.

In very simple terms, the source of the problem is obvious: There are few Black scientists because there are few Blacks in graduate science programs; there are few Blacks in graduate programs because there are few Blacks who are encouraged to take the undergraduate sources required for successful scientific careers; there are few Black undergraduates who are prepared by their high schools or grade schools to choose such courses. And at every point along the pipeline to a scientific career,

large numbers of the young Black men and women who could be scientists turn away. Where does this happen? Why does it happen? And what can be done about it? (Bechtel, 1989).

The shortage of Blacks among the ranks of scientists, engineers, and mathematicians is not the result of some recent misdirected social policy. Rather, it is one dimension of the larger story of Blacks in American society and needs to be understood by reviewing past ideologies, practices, policies, and expectations of Whites and Blacks (Bechtel, 1989). It is necessary to examine the sociohistorical links among attitudes about race, educational policies, and the social structure of science. All three have worked to prevent Blacks from entering science or from having their scientific contributions acknowledged and rewarded.

This article focuses on the contributions of African Americans to scientific and technological innovations. It was written not to disprove or discredit nonminorities who were given full credit for an invention or contribution to technological society but to recognize the contributions of Africans and African Americans who significantly helped mold and direct the evolution of technology. This article is also intended for technology education teachers to use as a tool to encourage African American youth to realize that they have a very brilliant heritage and wealthy history. This paper attempts to reveal a legacy of intelligence, and it serves to inspire future African Americans to keep the torch of technological innovation and invention aflame.

During the first half century of the nation's history, in New England and the mid-Atlantic states specifically, revolutionary spirit, growing abolitionist sentiment, and Christian missionary fervor favored the education of Blacks. The work of various religious groups, most notably the Quakers, to establish schools for Blacks is well documented. The efforts to provide instruction to Blacks during this period were generally local and unconnected, reflecting the interests of the diverse groups involved. Thus, some

communities provided integrated public instruction while others had separate facilities. The growing intensity of antislavery sentiments in parts of the North prompted some communities to adopt policies that would allow more Blacks to attend public schools (Franklin, 1973; Frazier, 1949; Woodson, 1915).

The results of this movement were impressive as free Blacks took advantage of opportunities to get an education. Of the 2,000 Blacks in Boston in 1850, almost 1,500 were in school; and in the states and territories as a whole, 32,629 Blacks were in school in 1860. Blacks also began to move into higher education. In 1826 Edward Jones graduated from Amherst while John Russwurm was getting his degree from Bowdoin -the first Black to graduate from college in America. Blacks were attending Oberlin and other institutions of higher education well before the Civil War (Franklin, 1973; Pifer, 1973).

Although most of these educational efforts were provided and controlled by Whites, Blacks also played a role. A few schools were established by Blacks, and in such large cities as Philadelphia Blacks began to organize literary societies as early as the 1780s (Funke, 1920; Winston, 1971).

The social climate in the South during the slavery era effectively precluded educating Blacks. Interest in public education in general was low. Whites who wanted schooling were expected to rely on their families for financial support. There were a few isolated efforts to provide free Blacks with an education, and some progressive plantation owners felt morally bound to teach their slaves to read and write. Any possibility of these practices gaining widespread support quickly vanished with the abortive revolts by Prosser (1800) and Vesey (1822), and the Turner rebellion (1831). These actions by Blacks who had been educated so frightened the planters that laws were passed throughout the South making it illegal to instruct any slave or free Black (Franklin, 1973; Funke, 1920; Low & Cliff, 1981).

During the decade of Reconstruction following the Civil War, Blacks made temporary gains in their social and political conditions. Passage of the Thirteenth, Fourteenth, and Fifteenth Amendments to the Constitution and the Civil Rights Act of 1866 gave Blacks

freedom and rights of citizenship and hindered restrictive legislation that attempted to reestablish antebellum social relationships (Bond, 1934; Brawley, 1970). Probably the most significant change came in the area of education. The emancipated slaves were eager to take advantage of their new status and felt that getting an education was of primary importance. And many individuals and organizations interested in aiding the freedmen were quick to offer their services (Woodson, 1969).

Even before the war ended, missionaries began to make their way into the Southern states to establish educational programs for those Blacks freed by the advancing Union troops. Immediately after the war, religious organizations, such as the American Missionary Association and the government-sponsored Freedmen's Bureau, established schools in the South. Blacks responded eagerly, and thousands were attending schools by the late 1860s (Bond, 1934; Cruden, 1969; Funke, 1920).

White Southerners, however, were unprepared for such a radical change and opposed efforts to provide education for Blacks, who were considered innately inferior—the idea of educating them was viewed as absurd. Providing educational opportunities to Blacks would have meant extending a privilege that had historically been restricted to the upper classes in the South; it would elevate the former slave to a status higher than that of most former slave owners. Conservative Southerners feared that the schools taught by Northerners would instill Republican ideals of equality and further undermine their political power. The hostile reaction by Southerners to Black education was a predictable part of their attempt to maintain the traditional antebellum social order in the face of massive social dislocation (Bechtel, 1989).

Nevertheless, some Southern Whites grasped an obvious fact: The Freedmen would have to be educated simply to survive and provide for their own basic needs. At the end of the Civil War, 95% of the Black population in America was illiterate. To most enlightened observers, the presence of this large number of “ignorant Black rabble was a menacing Trojan horse” (Winston, 1971, p. 681). White Southerners faced a serious dilemma that went beyond simple questions of educational philosophy. The way this problem was addressed would have a significant impact on important issues of

political and economic relationships because once Whites chose to educate Blacks, they had to decide what type of education should be provided. And that decision ultimately depended upon the role that Whites saw for Blacks in the American social order.

From an egalitarian perspective, education is a means of raising those less fortunate up to a level on par with the rest of society. If such a goal had been paramount at the end of the Civil War, what sort of educational program could have been developed? Ballard (1973) described a possible scenario.

First, there would have to be federally funded elementary schools in every village. Second, a federally funded group of highly trained teachers would have been sent to those villages. Centers of literacy would have to be established for adult education. This first thrust could have carried through for five to ten years, to be followed by the establishment of regional high schools with both vocational and academic curricula to serve as the funnel through which the most able Black youth would have gone on to federally subsidized colleges. Over a period of fifty or seventy-five years the educational level of the Africans would have risen to that of White Americans. (p. 11)

Ballard makes clear that it was unthinkable that Whites during Reconstruction would have allowed anything of the sort. If Blacks had to be educated, White Southerners felt that the education should be suited to their inferior mental capacities and to their proper, subservient place in society. With the goal decided upon, the two pillars of post-Reconstruction Black educational philosophy emerged: a system of separate and unequal schools for Blacks and industrial education.

During Reconstruction, the quality of education provided in the South had been generally poor for both Blacks and Whites, but it was administered on a fairly equal basis. After the end of Reconstruction and the reemergence of Southern conservatives in political power, the policies of Black social and political disenfranchisement extended to Black education as well. Through deception, blatant discrimination, and law, White schools were improved at the expense of Black schools. An examination of the data on school expenditures from the mid

1870s to 1930 clearly reveals the massive disparities between the education of Whites and Blacks in the South.

Data (Bond, 1934) for the state of Alabama indicate the changes that took place over the 55-year period from 1875 to 1930. During the 1875-1876 school term, Alabama spent an average of \$1.30 per pupil for White teachers' salaries and \$1.46 per pupil for Black teachers' salaries. This difference in favor of Black teachers reflects the impact of the Reconstruction administration. By 1885, however, Alabama was paying Black teachers 85% of what was paid to White teachers (\$1.09 versus \$1.28). And 25 years later, Black Alabama teachers still received only \$1.10 per pupil whereas their White counterparts got nearly six times as much (\$6.42).

Although the figures from Alabama show the dramatic decline over time in expenditures to Black teachers, the data from Tennessee reveal no change whatsoever over the 60-year period from 1870 to 1930. In 1870 Tennessee paid its White teachers \$11.83 per pupil compared to \$7.48 for Black teachers—63% of the White teachers' salary. By 1931 Tennessee was paying its White teachers \$27.55 per pupil compared to \$17.25 for Black teachers—again only 63% of the White teachers' salary (Bond, 1934).

Harlan (1968) noted that the regional differences in funding for White schools paled when compared to the economic disadvantages suffered by Black schools. In 1915 the North Central states spent an average of \$28.00 per White child for education compared to only \$14.00 per White child in South Carolina. But at the same time, South Carolina was spending only \$1.13 per Black child for education.

Statistics revealed the degree of inferiority of funding of Black education compared to that of Whites in the South. Using Washington, DC, as a point of comparison, one finds that spending by the six Southern states on school expenses, school property, and teacher salaries falls far short of anything that could be remotely called "equal" education. The breadth of the discrimination against Black education is revealed in other areas as well. For example, during the 1933-1934 school year, 10 Southern states spent a total of \$20 million on transporting rural school children. But, only 3% of this money was spent on Black children who constituted

34% of the total school population. In 1935-1936 over half (55%) of the 24,405 Black public elementary schools in the 18 states with separate schools were one-room schools. In terms of total property value, in 10 Southern states for which data were available, for every \$1.00 invested in school property for each White student, only \$0.19 was invested for each Black student (Frazier, 1949).

Factors other than direct discrimination in finances also undermined the ability of Blacks to acquire an adequate education. Black attendance remained relatively low because Black schools were often distant and so little transportation was provided. But because the number of Black teachers was also small, the typical teacher in a Black school would, on the average, have twice as many students as the typical teacher in a White school. Possibly most damaging was the practice of having shorter terms for the Black schools. In the 1929-1930 school year, for example, the average length of the term for the 18 Southern and border states, including Washington, was 164 days for Whites and 144 days for Blacks. However, in South Carolina the average school term was 173 days for Whites compared to only 114 days for Blacks (Work, 1931). After eight years of school, the typical Black student in South Carolina would have been in class 472 days less than the typical White student—in other words, he or she would be approximately four years behind. This policy, combined with the fact that few secondary schools were established for Blacks, goes far toward explaining why few Blacks during this period attained more than a sixth-grade education (Rice, 1971).

Much of this discussion of Black education has focused on the Southern states. One must not conclude that the educational experiences of Blacks in the North were any better. During the 18th and 19th centuries, Blacks were few in number in the North and West and did not arouse the fear and apprehension found in the South. Life was therefore different for those Blacks who lived in the various Northern states. They were not subject to the whims of a master, the restrictions on their activities were less severe, they could protest against injustices, and there were more opportunities for self-expression (such as churches and newspapers) and improvement in one's political and economic position (Litwack, 1961; Quarles, 1969).

Popular beliefs and attitudes about Blacks were not restricted to a particular region of the country, and the belief in Black inferiority was shared by most White Americans.

Discrimination and racial segregation were facts of life for Blacks in both the North and South. And the justification for such practices was the same everywhere: Blacks constituted an inferior race suited only for the most menial of positions (Litwack, 1961).

Despite having comparatively greater freedom in the North, Blacks found that there was strong opposition to their receiving an education. Many Northern states were unwilling to spend money on schools for Blacks, fearing that more of them would move into their states or communities seeking education. Northerners seemed no more fond of Blacks than Southerners. Ohio, Illinois, and Oregon had laws forbidding the migration of free Blacks into their states. Although Northern states did not pass laws prohibiting the teaching of Blacks, there was an undercurrent of resentment toward educating Blacks that found expression in the forcible closing of schools, the intimidation and driving away of teachers, and the destruction of school buildings (Beale, 1975; Bond, 1934).

While some White schools in the North admitted Blacks, this occurred mostly during the early 1800s. By 1830 most Northern states had excluded Blacks from White schools and required them to attend separate all-Black schools. Reflecting the prevailing belief in the limited intellectual capability of Blacks, these separate schools were often as unequal as those in the South, with substandard teachers, inadequate facilities, and inferior curricula (Litwack, 1961).

Frazier (1949) remarked that the problems facing Blacks in the public schools of the North were similar to those faced by the large number of immigrants who settled in the major urban centers. As with the immigrants, Blacks had been forced to live in the poorest sections of the cities and their children had to attend old, inferior, and overcrowded schools. Nevertheless, Blacks suffered additional problems: Because of their color, they were restricted in their movement both socially and economically. Greer (1973) noted that with varying degrees of speed, foreign immigrants were able to become part of American society, whereas Blacks remained on the margin. Both groups were vulnerable

because of their low social status, but it was the individual immigrant who suffered the consequences of economic change, whereas for Blacks the entire group was affected. Thus, caste through race added a significant dimension to the life of the lower class Black in the urban North.

Despite widespread animosity toward Blacks, they did receive more education in the North, although the quality of that education was inferior. Frazier (1949) reported figures for 1940 that show the proportion of Blacks with four years of high school in the South was only 25% of the total, whereas in the North it ranged from 50% to 75% of the total. The reality, however, is that North or South, Blacks in America received an inadequate and inferior education when compared to that available for more Whites.

The content of Black schooling adequately reflected White goals for Blacks in the social order. Industrial training was an effective way of ensuring that Blacks could not rise beyond what was seen as their natural sphere as laborers and servants.

Industrial education had its beginnings at Hampton Institute under the direction of General Samuel Armstrong, a Freedmen's Bureau administrator in Hampton, Virginia. A believer in the innate inferiority of Blacks, Armstrong thought that the best training for Blacks was one that would instill self-control and provide a check on what he believed was the natural tendency of Blacks toward rebellion. His program of education was intended to affect a change in the freedman's innately flawed character, to "civilize" the Black by instilling "habits of living and labor" (Spivey, 1978, p. 19). Armstrong believed that Blacks were ultimately destined to "form the working classes" and remain at the bottom of the economic hierarchy (Spivey, 1978). Having no faith in Blacks' intellectual capacity, Armstrong thought it was a waste of time to give them academic training, stating that courses involving "reading and elocution, geography and mathematics, history, the sciences . . . would, I think, make a curriculum that would exhaust the best powers of . . . those who would for years enter Hampton" (Spivey, 1978, p. 26). Thus, education at Hampton under Armstrong was designed to maintain the Southern status quo. Black students would be trained in the principles of agriculture, unskilled

menial labor, and domestic service—activities that would not be a threat to White skilled workers and would keep Blacks in their proper place in the social and economic structure (Spivey, 1978). But while Armstrong was the originator of vocational education, it took a Black man to make industrial training a prominent feature of Black education.

The few Blacks who managed to overcome educational obstacles and enter careers in science and technology still faced bigotry in other aspects of their lives. This discrimination extended to the lack of public recognition of names and accomplishments of Black scientists, medical researchers, and inventors. Only recently have scholars begun to search out evidence of these Blacks' contributions and discover that, although Blacks are rare in the history of American science, they are by no means missing or negligible. It is worth noting that, for many of the same kinds of reasons, the presence and activities of women in science were long overlooked by historians and only recently have been reexamined (Rossiter, 1974).

It is appropriate to describe briefly the work of some of these Black American scientists and inventors and to examine the ways in which they surmounted the formidable barriers to intellectual achievement.

Before the Civil War, the United States was not known for its scientific accomplishments. It would not make sense to expect Blacks to be the exception to this rule. For most slaves and free Blacks, the main issue was gaining and keeping their freedom. Many Blacks with exceptional abilities directed their talents to devising ways to gain their own freedom and to interest others in supporting such efforts. Inevitably, preachers and orators outnumbered inventors among the Black community during the antebellum period (Baker, 1913/1969).

It is also true that Black inventors, especially in the South, were unrecognized by historians. Slaves who invented mechanical devices to relieve the physical burden of labor could not protect their rights to the inventions (Baker, 1913/1969). They were not recognized as citizens and therefore could not enter into contracts. The federal government refused to grant them patents or to allow them to transfer patent rights to their owners. This did not preclude the outright theft of inventions by the slave owners,

who would claim them as their own. Given this situation, it can never be known how many inventions were originated by slaves (Haber, 1970). Among free Blacks, inventors preferred to have their race kept secret for fear that such information would impair the commercial success of their devices (Baker, 1913/1969).

Government restrictions on the granting of patents to slaves did not apply to free Blacks. For example, James Forten (1766-1842), a free Black Philadelphian, had no difficulty in getting a patent for his invention for handling sails or deriving a comfortable living from its manufacture. The same could be said of Norbert Rillieux. Born in New Orleans on March 17, 1806, Rillieux was the son of Vincent Rillieux, a wealthy plantation owner, and his slave Constance Vivant. Because of his father's position, the young Rillieux had the advantages of both freedom and wealth. He attended Catholic schools in New Orleans and studied engineering in France. At the age of 24, he became the youngest instructor in applied mechanics at L'Ecole Centrale in Paris and contributed papers on steam technology to engineering journals (Klein, 1971). His major accomplishment came in 1846 when he invented and patented a vacuum pan that transformed the process of refining sugar. The device yielded a superior product—granulated sugar—at a low price. The invention was a boon to the sugar industry in Louisiana and revolutionized the production of sugar worldwide (Baker, 1913/1969; Haber, 1970; Ploski & Williams, 1983; Toppin, 1971).

A discussion of early Black inventors cannot fail to mention the accomplishments of Benjamin Banneker. The son of a free Black mother and a slave she had purchased, Banneker was born in Baltimore County, Maryland, in 1731. Taught to read and write at home by his grandmother, Banneker also attended an integrated public school where he obtained the equivalent of an eighth grade education. In 1761, his curiosity about mechanical devices led him to construct a wooden striking clock so accurately made that it kept perfect time for over 20 years. His knowledge of astronomy and his mathematical ability enabled him to predict the solar eclipse of 1789. During the next 10 years he published an almanac of tables, eclipses, and medicinal formulas. His most notable contribution came as a surveyor with the team chosen by George Washington to develop the plans for the new national capital. Although

publicly recognized in France and England for his scientific accomplishments, he received little official recognition in the United States—although in 1970, Banneker Circle in Washington, DC, was named in his honor (Haber, 1970; Ploski & Williams, 1983; Toppin, 1971).

During the second half of the 19th century, a number of Black inventors produced devices of considerable importance in the mechanical advance of American industry. Most noteworthy were Lewis Latimer, Granville T. Woods, Elijah McCoy, and Jan Earnst Matzeliger.

Jan Matzeliger was born in Dutch Guiana in 1852. He immigrated to Philadelphia at the age of 10 and went to work in a shoe factory. He realized that while the tops and bottoms of shoes were being manufactured by machines, the two parts had to be put together by hand—a time-consuming bottleneck in the production process. He spent long hours at great physical and financial cost to do the seemingly impossible—invent a machine that would sew the top and bottom halves of manufactured shoes together. After Matzeliger developed his lasting machine, it was possible for one factory to produce 150 to 700 pairs of shoes a day, compared to 50 pairs sewn by hand. The cost of shoes went down, and the American shoe industry grew dramatically. Matzeliger died in 1889 at the age of 37 and never realized any of the millions of dollars that eventually derived from his invention (Haber, 1970; Logan & Winston, 1982; Ploski & Williams, 1983).

Elijah McCoy was born in Canada in 1844 to runaway slaves. He attended grammar schools in Michigan and went to Scotland to apprentice as a mechanical engineer. Upon returning to America, McCoy found that because of his race it was impossible for him to find employment as an engineer. He eventually took a job as a fireman on the Michigan Central Railroad where his experiences with maintaining the locomotive engines inspired him to invent a device that solved a critical problem in the manufacturing industry. Heavy machinery constantly needed lubrication to prevent the metal parts from fusing together. In the late 19th century, factory workers had to stop the machines and lubricate the parts by hand, a time-consuming and costly procedure. McCoy invented the “lubricating cup,” which provided continuous and automatic lubrication of moving

parts. His inventions were significant in perfecting the overall lubrication system eventually used in all large industrial plants with heavy machinery. Over a period of 40 years, McCoy acquired more than 50 patents for his lubrication devices, yet he died poor, as his race made it difficult for him to realize any profit from the inventions that made millions for others.

Although not documented, it is often claimed that the expression “It’s the real McCoy” is associated with his devices (Haber, 1970; Ploski & Williams, 1983).

In the area of electrical engineering, Granville T. Woods and Lewis Latimer deserve special recognition. Born in Ohio in 1856, Granville T. Woods attended school until the age of 10. First employed in a machine shop, he continued to develop his mechanical aptitude working on the railroad and reading books on electricity in his spare time. He reportedly took a course in electrical and mechanical engineering but was essentially self-taught. He invented a telephone transmitter in 1884 but is best known for his development of the Synchronous Multiplex Railway Telegraph. This system enabled communication between stations and moving trains and greatly improved railway safety. In the 20-year period from 1879 to 1899, 23 separate inventions bore his name, including the overhead conduction system for electric railways and the “third rail” used in most subway systems. Known as the “Black Edison,” he held over 60 patents, many of which were assigned to General Electric, Westinghouse, and Bell Telephone (Haber, 1970; Logan & Winston, 1982; Ploski & Williams, 1983; Toppin, 1971).

Lewis Howard Latimer was born in Massachusetts in 1848. At the age of 10, Latimer was forced to quit school and help support his family. After serving in the United States Naval Service during the Civil War, he was employed as an office boy with Crosby & Gould, Patent Solicitors. Demonstrating his superior skill after reluctantly being given the chance to try his hand at drafting, Latimer ultimately was named chief draftsman. Needing a skilled draftsman to help prepare his patent application, Alexander Graham Bell asked Latimer to prepare the drawings and descriptions for the telephone patent issued in 1876. Latimer eventually began to work on his own inventions, and in 1881, he developed a method of making carbon filaments that were longer lasting than previous filaments, greatly improv-

ing Edison’s incandescent lamps. He supervised the installation of electric lights in New York, Philadelphia, Montreal, and London. In 1884, Latimer joined the Edison Company, where he was instrumental in defending Edison’s patents in court (Haber, 1970; Logan & Winston, 1982; Ploski & Williams, 1983).

Most of the Black scientists and inventors of the 19th century were very gifted, self-taught individuals who lacked academic or professional training in the physical sciences. This should not be surprising since the description would apply equally to White American scientists and inventors at the same time. In fact, it was only in 1861 that the first doctorate was granted in a science—physics—at Yale University. Probably the most noteworthy accomplishment in the history of Blacks in science occurred just 15 years later. In 1876, Edward Alexander Bouchet, a 24-year-old Black man was awarded a PhD in physics from Yale University for a dissertation in geometrical optics entitled *On Measuring Refracting Indices*. Bouchet was the first Black to receive a doctorate from an American university and only the sixth person in the United States to be awarded a PhD in physics. Yet, other than an occasional footnote in the history of Black education, Bouchet and his accomplishments remain virtually unknown to the world of science and literally unheard of by the world in general. What happened to Bouchet provides a glimpse into the adversity facing educated Blacks in post-Civil War America.

Edward Bouchet was born in 1852 to free parents in New Haven, Connecticut, where he attended a public “colored school.” Like most of the schools for Blacks in the city, it was small, ungraded, and had only one teacher. In 1868, Bouchet was the first Black to be accepted into Hopkins Grammar School, a preparatory school for the classical and scientific departments at Yale College. During his two years at Hopkins, he studied Latin and Greek grammar, geometry, algebra, and Greek history. He graduated first in his class in 1870 and was chosen valedictorian (Bechtel, 1989).

Bouchet entered Yale University in the fall of 1870 and continued to excel. When he graduated in 1874, his grade-point average was 3.22 on a 4.0-point scale, the sixth highest in a class of 124. In 1875, Bouchet returned to Yale to pursue graduate work in physics. During his two years in the graduate school, he paid special

attention to chemistry, mineralogy, and experimental physics. Under the direction of Arthur Wright, he successfully completed his dissertation (Bechtel, 1989).

Bouchet's graduate education was encouraged and financed by Alfred Cope, a member of the board of managers of a Friends school for Blacks in Philadelphia, the Institute for Colored Youth (ICY). Firm believers in the value of liberal education and the unlimited capabilities of Blacks, Cope and the other managers offered at ICY a curriculum that included ancient history, geography, Greek and Latin classics, algebra, geometry, and chemistry. In an effort to expand the school's offerings, Cope established a Scientific Fund to promote learning in the principles of applied science. It was the establishment of the Scientific Fund that led Cope to invite Bouchet to head the new science program (Perkins, 1978).

Bouchet arrived in Philadelphia in the fall of 1876 and taught at the ICY for the next 26 years. However, as with all American Blacks during the last two decades of the 19th century, Bouchet's life took a turn for the worse. By the mid-1890s, many Philadelphia Quakers were becoming disillusioned with the Black community as they now questioned the ability of Blacks to respond to the efforts being made on their behalf. In 1894, a study made of the institute's curriculum suggested that it be simplified, stating that the courses were "pitched too high." By the end of the century, the new managers had become openly hostile to classical and academic education and receptive to Booker T. Washington's educational philosophy. In their efforts to redirect the ICY along the line of industrial training at Hampton and Tuskegee, the managers proceeded to fire all the teachers, including Bouchet, and replaced them with instructors favorable to industrial education (Bechtel, 1989; Perkins, 1978).

No White college would have considered him seriously for a position on its faculty even with his superior qualifications. But barriers other than race had an impact on Bouchet's career. The ascendance of vocational-industrial instruction during the latter half of the 19th century, and the overwhelming acceptance of the Hampton-Tuskegee model for Blacks in particular, served to limit Bouchet's opportunities. His academic education and his training in the natural sciences made him increasingly unattractive

as a candidate at Black colleges that had adopted the industrial-education philosophy. As noted by DuBois (1973), the debate between academic and industrial education was a bitter one. "The disputants came to rival organizations, to severe social pressure, to anger and even to blows. . . . Employment and promotion depended often on a Negro's attitude toward industrial education. . . . Men were labeled and earmarked by the allegiance to one school of thought or to the other" (p. 65).

The difficulties that the industrial-education movement created for Bouchet were tragic not only for him but also for the future generations of students he might have trained in science. The movement stopped students from striving for professional careers, it perpetuated stereotypes about Black intellectual inferiority, and it kept Blacks in economically inferior jobs. Even on its own terms, it misjudged the demand for Blacks in the trades, arousing the hostility of White workers. It failed to see that the rise of large corporations would put many tradesmen and craftsmen out of business (DuBois, 1973; Franklin, 1973).

Although Whites enthusiastically endorsed industrial training for Blacks and helped to implement it through contributions to Black schools, it is noteworthy that some Blacks resisted. W. E. B. DuBois led this movement against industrial education, while leaders at some Black colleges refused to change their curriculum in the direction of Tuskegee and Hampton. An important change occurred at the beginning of the 20th century as a small number of men and women began to move into the fields of science and engineering. Consider, for example, three Blacks who made scientific contributions to biology and medicine: E. E. Just, Percy Julian, and Charles Drew (Bechtel, 1989).

Born in Charleston, South Carolina, in 1883, Ernest Just received his bachelor's degree with honors from Dartmouth. In college he developed an interest in biology, especially cell structure and development. After graduating from Dartmouth, he taught biology at Howard University and began a 20-year period of summer research at the Marine Biological Laboratories at Woods Hole, Massachusetts. In 1916, he received his PhD in biology from the University of Chicago. During his career, he published two books and over 60 papers in scholarly journals. His ideas on cell-membrane

activity completely changed the scientific opinion of his time as he successfully demonstrated that the cells' cytoplasm and ectoplasm are equally important as the nucleus in heredity. As with most of the Black scientists of the period, Just never received proper recognition in the United States, although he was respected and honored in the scientific capitals of Europe (Haber, 1970; Manning, 1983; Ploski & Williams, 1983; Toppin, 1971).

Born in Alabama in 1899, Percy Julian attended DePauw University, where he was valedictorian and Phi Beta Kappa. He taught at Fisk, Howard, and West Virginia State College before attending Harvard and the University of Vienna. A specialist in derivative and synthetic drugs, Julian discovered cortisone, a cheap and effective treatment for arthritis derived from soybean oil. In 1935, Julian was the first to synthesize physostigmine, important in the treatment of glaucoma. He was also the first to synthesize hormones, greatly reducing the cost of these drugs and making them available to thousands of people who were unable to afford the expensive natural drugs. He was offered the post of chief chemist and director of research for the Glidden Company in Chicago, the first Black scientist to obtain such a prestigious position. This was a turning point in the struggle of Black scientists to gain access to America's research facilities (Haber, 1970; Ploski & Williams, 1983; Toppin, 1971).

Charles Drew, medical doctor and researcher, was educated at Amherst College in Massachusetts and took his medical degree from McGill University in Canada. Early in his career, he became interested in the problems associated with the transfusion and storage of blood. He took a teaching position at Howard University and while working on his doctor of science degree at Columbia wrote a dissertation on banked blood. He soon became an expert on separating and storing blood, and his research on blood plasma is credited with saving many lives during World War II. In 1941, he was called to England to help with the problems of blood storage and set up the first blood bank in England. Drew was one of the first Blacks to become a diplomat in surgery and the first Black to be appointed an examiner by the American Board of Surgery (Haber, 1970; Ploski & Williams, 1983; Toppin, 1971).

To this discussion of unrecognized scientists must be added several others. One is Charles H. Turner, who received his doctorate from the University of Chicago in 1907. He published many papers in the area of animal behavior, and the phenomenon of insect activity referred to as "Turner's circling" is named for him. William A. Hinton was an authority on venereal disease and responsible for developing the Hinton Test for detecting syphilis. In 1949, he became the first Black professor of medicine at Harvard. Lloyd A. Hall was chief chemist and director of research for Griffith Laboratories in Chicago. He transformed the meatpacking industry with his development of curing salts for processing and preserving meats. Louis Tompkins Wright was a leading surgeon and medical researcher best known for his work in developing the intradermal method of smallpox vaccination. He also pioneered in drug therapy for cancer and was the first to use chlortetracycline on humans. A graduate of Harvard Medical School, Wright was the first Black to be elected to a fellowship in the American College of Surgeons (Haber, 1970; Logan & Winston, 1982; Ploski & Williams, 1983).

There is little doubt that White scientists of this caliber won recognition from the scientific world in the form of research grants, prestigious positions, and prizes. More important, they were urged to continue their research and their teaching of future scientists. In light of the racism and discrimination these Black scientists faced, their accomplishments are even more impressive, yet their names and deeds remain obscure. Students quickly learn the importance of such men as Benjamin Franklin, Eli Whitney, Thomas Edison, Alexander Graham Bell, and Jonas Salk. These individuals are held up as great scientists and inventors whose work was instrumental in the transformation of American society. Students rarely learn the names Benjamin Banneker, Norbert Rillieux, Granville T. Woods, Lewis Latimer, or Percy Julian, or their equally important contributions to the transformation of American science and industry.

The achievements of Black intellectuals and scientists in White America have been largely obscured, ignored, or diminished in importance. The world of science and research was the private domain of White males. Society provided Blacks with more appropriate arenas for gaining

success and notoriety, arenas more fitting for their place in the American social order. The roles of gladiator and jester have long been traditional among powerless people and are often seen by the dominant group as more appropriate than that of scholar or scientist (Lewis, 1972). According to the stereotype, Blacks were to perform, produce, or entertain, not invent, design, or create. The former activities require only simple innate abilities; the latter intelligence and creativity—characteristics not thought to be present in Blacks.

From the perspective of White America at the turn of the century, educated and intellectual Blacks presented a grave problem. They were not supposed to exist, and the fact that they did exist challenged the very foundation of the White belief in Black intellectual and social inferiority (Winston, 1971). Therefore, such individuals had to be explained away (they were called freaks), minimized (they were accused of stealing their ideas from Whites), hidden (they were not acknowledged), or destroyed (they suffered discrimination and violence). The lives of early Black scientists were filled not only with the challenge and elation of scientific discovery, but with the specter of racism and discrimination as well.

During his brief tenure at St. Paul's College in Lawrenceville, Virginia, Edward Bouchet was respected and admired in the community. Nevertheless, he was assaulted by a White lawyer he accidentally bumped into as they came around a corner (Bechtel, 1989). Percy Julian was denied appointment as head of DePauw's chemistry department because he was Black, and he would not go to Appleton, Wisconsin, for a job interview because of a city statute prohibiting Blacks from staying overnight. During his tenure at Glidden, his house in Oakbrook was set afire and bombed in several acts of racial violence. Ernest Just, despite his scientific discoveries, was never offered an appointment at a major American research center or university and was urged by Whites to teach at Black universities in order to help his race (Haber, 1970; Logan & Winston, 1982; Manning, 1983).

More important than these acts of racism toward individuals are the patterns of institutional discrimination that created an almost insurmountable obstacle to the Black scientist. Segregation produced isolation: Black PhDs in

science were forced to teach in Black colleges and high schools, which were often unsympathetic to the needs of a research scientist. Edward Bouchet and Charles Turner spent most of their careers in high schools with limited resources and poorly equipped labs. Those who were fortunate enough to find positions in Black colleges (like Just or Julian) often taught students from the inner city or rural areas, who lacked advanced training in mathematics and English. These teachers seldom had the scientist's pleasure of training students to surpass their mentors. Black colleges had little money available for scientific equipment or libraries. In the South, where most Black colleges were located, Black scholars were denied use of public libraries and White university laboratories and were barred from local chapters of learned societies (Julian, 1969; Winston, 1971).

To this can be added Jim Crow laws designed to restrict the social and political actions of Blacks, the constant threat of violence reinforced by numerous lynchings every year, and the exclusion from the community of science in general. In this type of restricted and fearful environment, the PhD degree was a farce (Julian, 1969). Excluded because of their race from full participation in the American scientific community, these scientists languished in obscurity.

Under such historical conditions, it is no wonder that so few Blacks chose to study science. Ernest Just's motive in discouraging his students from pursuing careers in science grew out of his own bitter recognition of the reality they faced (Manning, 1983; Winston, 1971). For Blacks at the turn of the century, education had to provide marketable skills, a point of view that continues to direct scientifically talented students into careers in education, medicine, or law rather than biology, physics, or chemistry. For any Black who knew about Just, Julian, or Turner, the lesson was clear: Even those with the highest level of education and degrees from America's most prestigious universities were denied the recognition and respect befitting their qualifications and scientific accomplishments. In the fields of medicine, teaching, and law, one could find jobs and prosper, albeit while restricted to serving a Black clientele. Under the rules made by Whites concerning the roles Blacks were to play in American society, the pragmatic Black decided it was better to be

an employed teacher or lawyer than an under-employed scientist.

Specific evidence supports this argument. Edwards (1959), in a survey of 300 Black professionals, found that half of the respondents had given serious consideration to careers other than the one they presently had. Many expressed a primary interest in becoming engineers, architects, or research scientists but felt that Blacks could not earn a decent living in these occupations. One of Edwards's respondents, a physicist now working as a teacher, had wanted to enter the field of engineering. He changed his mind when it became clear that despite his ranking near the top of the class, White classmates who were far below him could get jobs as student laboratory technicians while he could not.

The Black scientist is both rare and relatively unknown: rare because of an educational philosophy that produced laborers not scholars, and unknown because White society has often refused to recognize the contributions of those able to overcome the obstacles placed before them. In part, this failure to recognize the Black scientist stems from beliefs about Black inferiority. To acknowledge these individuals would be to demonstrate the fallacy of those beliefs and the effort of the policies that deprived Blacks of equal and quality education.

Separate, unequal, and discriminatory educational policies served to keep a generation of Blacks at the bottom socially, politically, and economically. And while a few (such as Bouchet, Just, and Julian) were able to break through and acquire a quality education, being Black meant that in most instances the rewards were withheld. The rare Black scientist was faced with a lack of research facilities, funds, and recognition for achievements that by any standard were of superior quality and importance. Given the historical conditions, one can understand why Black scientists were treated in such a manner. But to understand is not to justify. Educational policies served to suppress and demoralize generations of Blacks in America, creating discreditable castes within an ostensibly open society.

History is more than description and explanation; one can often use the past to examine the present. What has the past taught with regard to current educational policies directed toward Blacks? Several major themes can be

identified. First are *interest* and *motivation*. Historical evidence shows that Blacks in America had a strong interest in and motivation for getting an education. This desire continues as large numbers of Blacks seek higher education. Second is *opportunity*. The evidence is just as clear that Blacks were denied the opportunity for a quality education by legal and extralegal means. Today, Blacks are able to take advantage of educational opportunities as many of the barriers of the past have been removed. And third, is the *reward* or *payoff*. Given the historical conditions, for most Blacks there was no payoff for getting an education. Today, the picture appears more positive as Blacks are found in all professions and at all levels of achievement (Betchtel, 1989).

Yet, below the surface a different image can be seen. Less than 2% of all doctoral scientists in America are Black, and few Black students take courses in the sciences or express a desire to pursue such careers. For those who complete graduate school, the door to a science career is opened. The problem, as in the past, remains at the level of basic educational opportunity and experience. America has desegregated its White schools and has renounced its past practices as counterproductive and mean-spirited. But those practices remain, in effect, in the form of tracking, curriculum reform, and teacher expectations.

Eighty years ago, vocational education served to perpetuate Black social and economic inferiority, locking a generation of Blacks into low-paying, low-status jobs. Today, Black children are bused to excellent schools in an attempt to equalize educational opportunity. Yet once off the bus and in the school, they are tracked, counseled, or intimidated away from academic courses into less rigorous curricula. At the turn of the century, the typical student at Hampton or Tuskegee learned simple trades and domestic skills while American industry was going through a transformation that was making such skills obsolete. Today, the typical Black student studies a watered-down curriculum devoid of higher level math and science courses while we are living in a computer age that is transforming the world into a more complex and scientifically sophisticated arena (Bechtel, 1989).

To break the hold of the past, parents, educators, and policymakers need to move forward

and address the educational deficiencies that continue to derail the scientific careers of Black students in America.

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References

- Baker, H. E. (1969). *The colored inventor* [Reprint]. New York: Arno Press. (Original work published 1913)
- Ballard, A. B. (1973). *The education of Black folk: The Afro-American struggle for knowledge in White America*. New York: Harper & Row.
- Beale, H. K. (1975). The education of Negroes before the Civil War. In J. Barnard & D. Bruner (Eds.), *The American experience in education* (pp. 85-97). New York: Franklin Watts.
- Bechtel, H. K. (1989). *Edward Alexander Bouchet: America's first Black doctorate*. Paper presented at the annual meeting of the Mid-South Sociological Association, Jackson, MS.
- Bond, H. M. (1934). *The education of the Negro in the American social order*. New York: Prentice-Hall.
- Brawley, B. (1970). *A social history of the American Negro*. New York: Macmillan.
- Cruden, R. (1969). *The Negro in reconstruction*. Englewood Cliffs, NJ: Prentice-Hall.
- DuBois, W. E. B. (1973). *The education of Black people: Ten critiques, 1906-1960*. Amherst: University of Massachusetts Press.
- Employment and Earnings*, Department for Professional Employees, AFL-CIO Vol. 50, No. 1, op. cit.
- Edwards, F. G. (1959). *The Negro professional class*. Glencoe, IL: Free Press.
- Franklin, J. H., A. A. Moss, Jr. (2000). *From slavery to freedom: A history of African Americans*. New York: Knopf, 8th edition.
- Frazier, E. F. (1949). *The Negro in the United States*. New York: Macmillan.
- Funke, L. (1920). The Negro in education. *Journal of Negro History*, 5(3), 1-21.
- Greer, C. (1973). Immigrants, Negroes, and the public schools. In M. B. Katz (Ed.), *Education in American history* (pp. 284-290). New York: Praeger.
- Haber, L. (1970). *Black pioneers of science and invention*. New York: Harcourt Brace & World.
- Harlan, L. R. (1968). *Separate and unequal: Public school campaigns and racism in the southern seaboard states, 1901-1915*. New York: Atheneum.
- Julian, P. L. (1969). On being scientist, humanist, and Negro. In S. L. Wormley & L. H. Fenderson (Eds.), *Many shades of Black* (pp. 147-157). New York: Morrow.
- Klein, A. (1971). *Hidden contributions: Black scientists and inventors in America*. New York: Doubleday.
- Kusmer, K. (1991). *Black community and urban development in America 1720-1990*. Philadelphia: Temple University Press.

- Lewis, H. (1972). *Changing aspirations, images, and identities*. In K. B. Clark et al. (Eds.), *The educationally deprived: The potential for change* (pp. 30-46). New York: Metropolitan Applied Research Center.
- Litwack, L. (1961). *North of slavery: The Negro and the free states, 1790-1860*. Chicago: University of Chicago Press.
- M. R. Winston, & Logan, R. W., (1982). *Dictionary of American Negro biography*. New York: Norton.
- Low, A. W., & Cliff, A. (1981). *Encyclopedia of Black America*. New York: McGraw-Hill.
- Manning, K. R. (1983). *Black Apollo of science: The life of Ernest Everett Just*. New York: Oxford University Press.
- Perkins, L. M. (1978). *Fanny Jackson Coppin and the Institute for Colored Youth*. Unpublished doctoral dissertation, University of Illinois at Urbana-Champaign.
- Pifer, A. (1973). *The higher education of Blacks in the United States*. New York: Carnegie Corporation.
- Ploski, H. A., & Williams, J. (1983). *The Afro-American* (4th ed.). New York: Wiley.
- Pursell, C., Ed. (2005). *A hammer in their hands: A documentary history of technology and the African-American experience*. Cambridge, MA: The MIT Press.
- Quarles, B. (1969). *The Negro in the making of America*. New York: Macmillan.
- Rossiter, M. W. (1974). Women scientists in America before 1920. *American Scientist*, 62, 312-323.
- Sinclair, B., Ed. (2004). *Technology and the African-American experience: Needs and opportunities for study*. Cambridge, MA: The MIT Press.
- Spivey, D. (1978). *Schooling for the new slavery: Black industrial education, 1868-1915*. Westport, CT: Greenwood.
- Toppin, E. A. (1971). *A biographical history of Blacks in America since 1528*. New York: McKay.
- Winston, M. R. (1971). Through the back door: Academic racism and the Negro scholar in historical perspective. *Daedalus*, 100, 678-719.
- Woodson, C. G. (1915). *The education of the Negro prior to 1861*. New York: Putnam.
- Woodson, C. G. (1969). *The mis-education of the Negro*. Washington, DC: Associated Publishers.
- Work, M. N. (1931). *Negro year book: An annual encyclopedia of the Negro, 1931-1932*. Tuskegee, AL: Negro Year Book.

