

PERCY JULIAN

RISE ABOVE RACISM

By Christen Brownlee

On the day that Percy Julian graduated from college, his grandmother showed him, for the first time, the deep scars that ran down her shoulders. The scars were left over from a vicious beating she had received as a slave during the final days of the Civil War. Now, two generations later, slavery no longer existed in America, and Julian, an African-American man, was graduating with a chemistry degree at the top of his class. "This is worth all the scars," his grandmother said as she held his Phi Beta Kappa key.

Early life

Julian was born in 1899 in Montgomery, Alabama. Julian's family didn't have much money during his childhood, but he did have the encouragement of his parents—his father, a railroad mail clerk, and his mother, a school teacher. Although it was almost unheard of at the time for African-American children to go to school beyond the eighth grade, Julian's parents pushed their six children to get as much education as possible. So, when Julian graduated from high school in 1916, he applied to DePauw University in Greencastle, IN.

At that time, DePauw accepted only a few African-American students and did not permit them to live in the school's dorms. Julian managed to find an off-campus boarding

house to stay for a few days when he first arrived in town. But, to his surprise, the house wouldn't serve him meals because of his race. Days passed before he found a place to eat in town. Julian eventually found a job in a DePauw fraternity house, firing the furnace and doing other odd jobs. In exchange, the fraternity let him live in the basement and eat at the house.

Julian worked hard in school, and his efforts paid off. He graduated from DePauw University as class valedictorian. Julian intended to continue his chemistry studies by attending graduate school to earn a doctoral degree in the subject. However, he soon learned that joining a doctoral program would prove difficult. Universities across the country—whose student populations were predominantly White—denied him entrance, since, as an African-American man, the only jobs for which he'd be eligible after graduation would be teaching at universities for African-Americans.

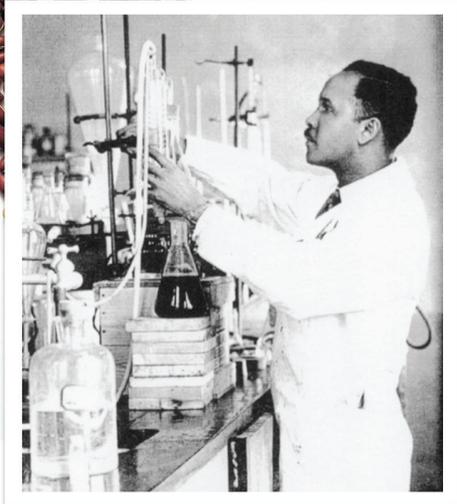
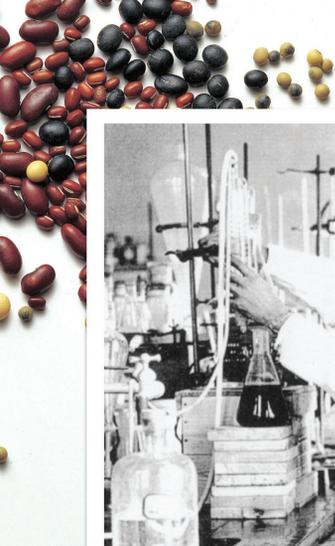
While pondering his next step, Julian got a job teaching chemistry at Fisk University in Nashville, TN. After two years at Fisk, he won a scholarship for graduate studies in chemistry at Harvard University in Cambridge, MA.



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However, he was only at Harvard long enough to earn his master's degree and not the doctorate he desired. Historians speculate that the school administration would not allow him to teach White students, the most common way for doctoral students to fund their studies. Without that opportunity, Julian would not have had the money to continue attending Harvard.

After leaving Harvard, Julian found teaching positions at West Virginia State College and Howard University. However, he continued to look for creative ways to complete the graduate studies in chemistry. Julian found the answer in a fellowship he received from the Rockefeller Foundation in 1929. He decided to use the fellowship to study overseas, where he felt discrimination wouldn't be such a hardship. He continued the graduate studies started at Harvard at the University of Vienna in Austria.



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In a huge contrast to the United States, life in Vienna was unlike anything he'd ever known. Rather than being segregated from his peers and treated like a second-class outsider, he finally felt like a full participant at the university. He mixed and mingled at intellectual gatherings, and even started going to the opera.

Potent plants

While enjoying the freedoms that life in Austria provided, Julian worked diligently toward his doctorate. He worked to identify the structure of the active ingredients in *Corydalis cava*, an Austrian shrub that could soothe pain and ease heart palpitations. Scientists didn't know how the active ingredients in the shrub worked; however, elucidating the structures of these compounds was a logical first step.

Scientists did know that the compounds of interest were alkaloids. Alkaloids are a class of nitrogen-containing compounds found mostly in plants. Many alkaloids act as drugs. For example, caffeine, nicotine, and quinine (the oldest known antimalarial agent) are alkaloids.

To begin to solve the puzzle, Julian pulled some of the plants' alkaloids apart atom by atom and finally succeeded in iden-

tifying their structure—a first step to learning their function. The research earned him his Ph.D. in 1931, just three years after he started the program.

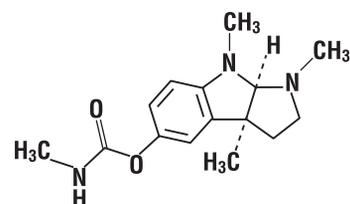
Magic beans

When Julian returned to the United States, he got a job as full professor and chemistry department chair at Howard University in Washington, DC. Unfortunately, he found himself embroiled in university politics and resigned after just a year. The experience wasn't totally fruitless, though—he met his future wife at Howard, and they married three years later.

After leaving Howard, Julian wasn't sure how to revitalize his career. Eventually, he got a job as a researcher at his alma mater, DePauw University. He knew he needed to do something right away to get back on track, so he took on a risky project that would either boost his career or bring it crashing down. He decided to synthesize, or make from a set of simple ingredients, an alkaloid called physostigmine.

transformed into the desired chemical and in much greater amounts than naturally available.

That was the case for physostigmine. Because the calabar bean, the natural source for physostigmine, contains only a tiny amount of the compound, the drug was rare and expensive. Scientists wanted more of this alkaloid to treat glaucoma, a devastating eye disease, which causes an increase in the pressure inside the eye leading to possible blindness.



Physostigmine

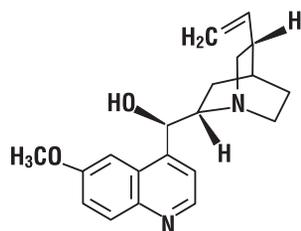
Another chemist, Sir Robert Robinson, seemed to be close to synthesizing this compound himself. Yet, Julian was sure he could beat Robinson to it. Julian brought over a friend from Vienna, a chemist named Josef Píkl, to help him with the project. Together, the two scientists worked in a frenzy to complete the synthesis before Robinson. To their disappointment, Robinson published first, claiming that he had successfully completed the synthesis of physostigmine. However, upon reading Robinson's paper, Julian and Píkl thought something looked amiss—the melting point for one of Robinson's intermediate compounds didn't match its natural counterpart.

For a synthesis to be correct, man-made compounds must match the natural compounds in every way. Even something seemingly as small as the chemical's melting point can signal whether researchers correctly synthesized the intended compound. Julian and Píkl challenged Robinson's findings and published a new paper detailing their own synthesis of physostigmine, with the melting points of physostigmine and the intermediates in its synthesis identical to the natural compounds. Their synthesis ultimately proved correct.

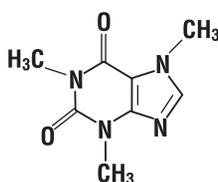
Lowly beans and other plants would prove to be the key to the rest of Julian's career. However, his success with physostigmine did not protect him from discrimination. Finding a job proved difficult, as potential employers refused to hire Julian when they learned of his race. He finally landed a job as director of research at Glidden, a paint and chemical company based in Chicago. Working



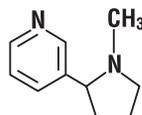
One reason scientists synthesize chemicals already found in nature is to mass-produce them. In the process of synthesis, scientists use simple and readily available starting materials to form intermediate compounds. Through a series of chemical reactions, these intermediate compounds are



Quinine



Caffeine



Nicotine

at Glidden was a big deal—hardly any African-American chemists worked in the industry in the 1930s. Julian used his position at Glidden to investigate the soybean, a plant he was sure had untapped possibilities.

Over the next few years, he racked up hundreds of patents for products he coaxed out of soybean plants, from paper coatings to protein-rich foods to a fire-fighting spray called Aero-Foam. Aero-Foam was used by the U.S. troops during World War II to extinguish gasoline and oil fires.

His biggest accomplishment came from a mishap that could have cost him his job. Water had leaked into a tank of pure soybean oil that Julian and his colleagues used for their work. Crystals and sludge had formed in the oil; Julian and his coworkers assumed the oil, worth thousands of dollars, was spoiled. But Julian saw something promising in those crystals. When he tested them, he found stigmasterol, a steroid.

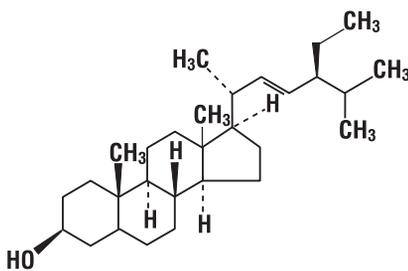
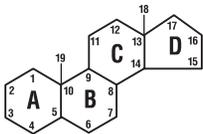
Steroids are fat-soluble compounds made of four fused carbon rings. Usually, three of the rings have six carbon molecules, and the fourth has five. There are hundreds of different steroid molecules, set apart by different chemical groups

(functional groups) that hang from the carbon rings.

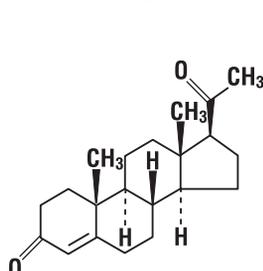
Julian was excited about isolating stigmasterol, a plant steroid, because it can easily be converted to

an animal steroid called progesterone. Progesterone was used to prevent miscarriage in pregnant women, but it was very expensive at the time. Julian's work, the isolation of stigmasterol on a large scale, made the synthesis of progesterone easier and increased its availability and affordability.

Steroid backbone



Stigmasterol



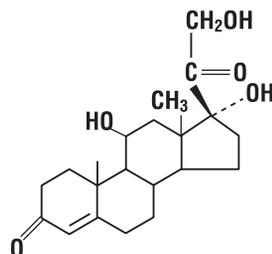
Progesterone



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Worth it

Julian was certain that the soybean plant had even more to offer, and he was right. In 1949, he announced that the plant could make another steroid that could easily be converted into a drug called cortisol. This drug worked miracles for rheumatoid arthritis sufferers—quickly easing their pain and swelling. However, like progesterone had been, cortisol was very expensive to manufacture. Another



Cortisone

scientist had patented a process to synthesize cortisol from a starter chemical found in cow bile. However, the process took 36 steps and used expensive chemicals.

Julian found that a steroid called Reichstein's compound S (also known as Compound S) could easily be isolated from soybean oil. This compound differed from cortisol by the presence of just one oxygen atom at Carbon 11.

The challenge became finding the easiest way to add a single oxygen atom to Carbon 11 on Compound S without altering the rest of the compound. Several teams of scientists around the world worked on this task.

The first to identify a solution was a team of scientists at the Upjohn Company in Michigan. The Upjohn team found that a common mold had an enzyme that could supply Compound S with the oxygen atom necessary to convert it to cortisol.

By making Compound S in bulk and oxygenating it in a specific position, Julian found an easy way to mass-produce cortisol, saving several steps in the synthesis and plenty of money.

He used his success with Compound S to launch his own company, Julian Laboratories, in 1953. Julian lured talented research chemists away from Glidden and other companies to work for him making steroid intermediates from soybeans and other plants. When it was discovered that Mexican yams were a more potent source of artificial steroids, Julian opened a plant in Mexico to harvest and process yams. These yams could be used to make Compound S, which he could then sell to companies specializing in cortisol synthesis. However, he was unable to get a permit to harvest the yams, and the plant sat unused for some time. Julian found a new source of yams in Guatemala and was able to proceed with his plan.

His business quickly grew beyond anything he'd imagined. He sold his company in 1961, for \$2.3 million. The sum made him one of the richest African-American men in the country. He used some of the money to launch the Julian Research Institute, a non-profit research organization.

After more than four decades of chemical research, Julian was elected into the National Academy of Sciences in 1973, one of the highest honors a scientist can receive. The U.S. Postal Service issued a commemorative stamp in his honor in 1993. In 1999, the American Chemical Society declared Julian's synthesis of physostigmine as one of the top 25 achievements in the history of American chemistry.

Julian died in 1975, but his legacy continues. His life's achievements—as a chemist and as a trailblazer against the racism of his time—may not be touted in the history books, but they represent a volume of improvements to the lives of everyday people. ▲



Christen Brownlee is a contributing editor to *ChemMatters*. Her article "Super Fibers" appeared in the February 2006 issue.