

# Percy Lavon Julian (1899–1975)

## A forgotten pioneer in soy

James Kenar

Percy Lavon Julian was born April 11, 1899, in Montgomery, Alabama, USA, to James Sumner Julian and his wife, Elizabeth Lena Adams. Percy was the oldest of six children and the grandson of a former slave. His father, James, was a federally employed railway mail clerk and, as such, their family was better off than most blacks of the day. Although, Julian had little formal school training, since limited public education was available for blacks at the time, he had a burning desire, encouraged by his family, to pursue higher education.

In 1916, he was accepted as a sub-freshman at DePauw University in Greencastle, Indiana. This meant that, in addition to his regular college courses, he took remedial classes at a nearby high school. Julian was not allowed to live in the college dormitories so he lived in an off-campus boarding home where he was refused meals. To pay his college expenses, he worked part-time at a fraternity house and also as a ditchdigger.

Even facing these obstacles he excelled, and in 1920, he graduated as valedictorian of his class with a chemistry degree. Although at the top of his class and wanting to further his education, Julian was discouraged from seeking graduate school admission because of potential racial issues. Instead, he took the advice of an advisor and took a position as a chemistry teacher at Fisk University, a black college in Nashville, Tennessee.

After two years at Fisk, Julian was awarded the Austin Fellowship in Chem-



*Percy Julian, speaking at the DePauw University 125th Anniversary Founders' and Benefactors' Day Banquet, January 12, 1962. Image courtesy DePauw University Archives and Special Collections. Reprinted with permission.*

istry and attended Harvard University in Cambridge, Massachusetts. Julian studied under Elmer P. Kohler, excelled as a graduate student, and obtained his master's degree in 1923. Again, obstacles appeared insurmountable as he pursued his doctorate degree. The university, worried that white students would resent being taught by Julian, withdrew Julian's teaching assistantship, and he was unable to complete his Ph.D.

This was a traumatic and disappointing blow for Julian. From Harvard he took a short-lived teaching position at West Virginia Collegiate Institute (now West Virginia State University, Institute, West Virginia), and then moved on to serve as an associate professor at Howard University in Washington, DC, and later, as head of the department of chemistry.

In 1929, Julian received a Rockefeller Foundation grant and the opportunity to earn his doctorate degree. Because the chemistry of natural products fascinated him, he elected to study plant alkaloid chemistry under the tutelage of Ernst Späth at the University of Vienna, Austria. Julian's doctoral work focused on the identification and isolation of complicated alkaloid structures found in plants and conjugated systems of organic compounds. Julian was noted by his peers for his neatness and contagious laugh, while Späth, a critical professor, characterized Julian in these words:

“Ein ausserordentlicher Student, wie ich ihn in meiner Laufbahn als Lehrer niemals hatte (An extraordinary student, his like I have not seen before in my career as a teacher).”

Julian proved to be an excellent chemist due to his single-minded persistence and careful observations of new and unexpected results. His aptitude for natural product chemistry turned into a skill that he was able to exploit in a timely manner again and again over the course of his life.

Julian received his Ph.D. in 1931 and returned to Howard University, accompanied by his friend and fellow doctorate, Josef Pikl. After two years there, internal politics forced them to leave, and in 1933, through the efforts of his former professor William M. Blanchard, Julian returned to DePauw University with Pikl as a research fellow to teach the senior courses in organic chemistry. He made the most of the opportunity, and with Blanchard's assistance, Julian boldly replaced the usual senior classes, Qualitative Organic Analyses, Organic Syntheses, and Literature Studies, and gave qualified students a fundamental research problem. The result? In four years the seniors, led by Julian, produced 30 senior theses that read more like doctoral dissertations than expanded senior theses. These senior theses resulted in 11 publications in the prestigious *Journal of the American Chemical Society (JACS)*.

Meanwhile, Julian and Pikl set an intense goal for students in Julian's own research laboratory to synthesize physotigmine, a plant alkaloid found in Calabar bean (*Physostigma venenosum*) extracts. These extracts were shown to cause contraction of the pupil, making it highly desirable as a medicine in the treatment of glaucoma and the target of synthetic organic chemists worldwide.

This research resulted in a series of five papers published in *JACS* that represented the turning point in Julian's career. The first three papers developed the step-by-step synthetic approach that described the chemistry of the needed precursors to synthesize physotigmine. The fourth paper, was entitled "The Synthesis of *d,l*-Eserethole," and *d,l*-eserethole was the key precursor needed to complete the physotigmine synthesis.

The paper was about to be sent to the editor of *JACS* when a series of 10 papers by world-renowned chemist Sir Robert Robinson of Oxford (awarded the Nobel Prize in Chemistry in 1947 for his investigations on plant products of biological importance, especially the alkaloids) on the identical subject were published.

It appeared that Julian had been scooped by Robinson along and his aspirations to put behind him past adversities had been stymied. Even more disturbing was that all the properties for Robinson's *d,l*-eserethole compound were different from Julian's findings. One of them was in error. Because Julian was confident that his 11-step synthetic route was not flawed, he altered his fourth paper to read:

"In a series of ten beautiful papers, Robinson and his co-workers have described syntheses of compounds which they call '*d,l*-Eserethole' and '*d,l*-Esermethole.' Their '*d,l*-Eserethole' is not the compound described in this communication as *d,l*-Eserethole, and the constitution of which can hardly be questioned. We believe that the English authors are in error, that the compound they describe as '*d,l*-Eserethole' is not the substance that we are describing for the first time the real *d,l*-Eserethole."

Julian's bold challenge of such an eminent scientist left no room for concession. If he and Pikl were wrong both their futures as scientists would be shrouded by doubt and their careers would be effectively ended. The outcome of the challenge culminated in the fifth and final paper entitled, "The

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Complete Synthesis of Physotigmine.” In this paper, Julian and Pikel proved conclusively that their synthetic route to *d,l*-eserethole and physotigmine was correct and that Robinson’s route was in error. Julian had finally made his mark in the scientific community as the publication of this paper received worldwide notice. Unfortunately, despite this scientific achievement, Julian was denied professorship at DePauw University because of his race and the university’s financial difficulties.

In conjunction with his synthesis of physotigmine, Julian had also been trying to isolate a companion alkaloid to physotigmine known as Geneserin from the Calabar bean. Serendipity struck as it does on occasion in a chemistry laboratory. Julian had extracted the oil from the beans, washed the oil with dilute acid and water, and set the oil aside wet. Several weeks later, crystals had formed in the oil. Upon analysis, the crystals turned out to be stigmasterol, a sterol isolated 29 years earlier from the same plant, *P. venenosum*. Again Julian saw a bigger picture. Familiar with the work of others to prepare natural compounds based on the sterol structure, Julian wrote the Glidden Co. to request five gallons of soy-

bean oil for future experiments. On receiving Julian’s request, the vice president of the Glidden Co. (W.J. O’Brien) called him to extend an invitation for an interview as Glidden’s Assistant Director of Research of the Soya Products Division. O’Brien was combing the scientific community to find the best scientific minds for Glidden’s research plans, put aside the color of Julian’s skin, interviewed Julian, and hired him on the spot with a salary of \$4,000/year.

Before the 1920s, soybeans were considered an industrial product only and not utilized as a food in the United States. Julian arrived at Glidden in 1936 and was assigned to exploit every ingredient of the soybean. At this time, Glidden was working to develop a sludge-free, nonsettling oil for its “Durkee Famous Food” division’s oleomargarine plant. Julian was put on 24-hour call as Glidden built a new, more efficient plant to process soybeans to replace an extraction processing plant that recently had been destroyed in an explosion. The next few years were hectic for Julian, and he forgot his ideas concerning stigmasterol and steroid chemistry. In his more than 18 years at Glidden, Julian solved many problems surrounding soybean oil processing and

developed many products: The Soya Products Division became Glidden’s most profitable single entity. Julian figured out how to isolate the proteins from soybeans, and a protein plant producing 40 tons of protein daily became a reality along with the development of soy phosphatides (sold today as lecithin granules). Both of these operations became hugely successful commodities for Glidden owing to Julian’s work. Julian also developed fire-retardant foam from soybean protein that became known as “Navy Bean Soup,” as it was used to extinguish fires on aircraft carriers during World War II. Glidden’s soybean oil became a preferred product for many, and Julian also became the director of research for the Durkee Famous Foods Division of Glidden in addition to his other duties. Julian built a strong

## information

■ Percy Lavon Julian (1899–1975) archive. Depauw University, [www.depauw.edu/library/archives/percyjulian](http://www.depauw.edu/library/archives/percyjulian).

■ An excellent video biography of Percy Julian’s life is NOVA: Forgotten Genius, NOVA (television series).

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research team, and together they applied for more than 100 patents.

Serendipity struck again in 1940. A plant worker called Julian to tell him that water had leaked into a 100,000-gallon (380,000-liter) tank holding purified soybean oil and a white solid had accumulated in the tank. Remembering the crystals of stigmaterol that he isolated from oil of the Calabar bean, and realizing that the extremely small amounts of sterols contained in soybean oil had been concentrated in the white solid, Julian collected and analyzed the solid. He found it to contain approximately 15% of a mixture of soybean sterols. Julian developed a procedure to precipitate the sterols cleanly from the oil and was soon producing 100 pounds of mixed sterols daily as a by-product, valued at \$10,000 a day. The soy stigmaterol was easily converted into commercial quantities of the female hormone progesterone, and the first pound of progesterone he made, valued at \$63,500, was shipped to the buyer in an armored car! Soon progesterone was put on the U.S. market in bulk at a greatly reduced cost and a healthy profit for Glidden. By the mid-1940s, Glidden's Soya

Products Division had a complete line of soya products from various grades of soybean oil, soy protein, soy flour, lecithin, and five feed products.

From there other hormones were commercialized. In 1948, Mayo Clinic (Rochester, Minnesota, USA) studies of the expensively produced steroid cortisone showed it to have amazing therapeutic attributes for rheumatoid arthritis. Again, not long after the announcement of these studies, Julian worked out, patented, and published a practical synthesis of sterol precursors needed to prepare cortisone, hydrocortisone, and their derivatives.

In 1953, when Glidden returned the focus of Julian's research to making paint, he left and founded Julian Laboratories in Oak Park, Illinois, and Laboratorios Julian de Mexico in Mexico City. But to keep Julian Laboratories going, Julian once again found himself facing racial discrimination in the form of denied loans from banks.

Over time, the company became successful, and Julian moved with his wife and two children into Oak Park, an affluent white Chicago suburb. There his home was the target of a bomb and a fire. Fur-

thermore, he fought with the Mexican government to win approval to harvest Mexican yams used in making steroids for his Mexico processing plant. In the end, after much work, Julian Laboratories was producing cost-effective compounds used in making many medicines. It also opened the door for other black chemists as Julian Laboratories employed more black chemists than any other facility in the country. In 1961 Julian sold Julian Laboratories to Smith, Kline, and French Pharmaceutical Co. (now GlaxoSmithKline) for more than \$2 million, and founded Julian Research Institute, a nonprofit organization dedicated to training young research chemists, where he served as director until his death in 1975.

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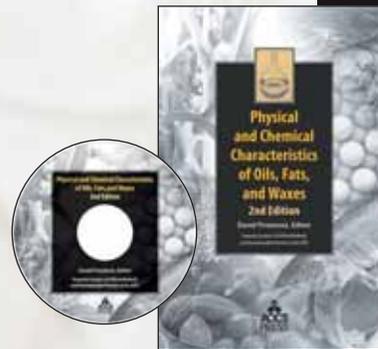
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