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Percy Lavon Julian

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PERCY LAVON JULIAN

Image from: "The Life of Percy Lavon Julian '20." DePauw University. N.p., 19 Feb. 2009. Web. 30 Apr. 2017.

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CLAIM TO FAME

Percy Lavon Julian was an African American chemist credited with the first total synthesis of physostigmine, a drug involved in the treatment of glaucoma. (6)

BIOGRAPHY

Percy Lavon Julian was born on April 11, 1899, in Montgomery, Alabama. He died of liver cancer on April 19, 1975. (6)

EDUCATIONAL LIFE

- Julian attended public school until the eighth grade; he was unable to continue on to high school because none were open to black students at the time. (6)
- He applied to DePauw University in Greencastle, Indiana, and took evening high- school level classes to get him to the academic level of his peers. (6)
- Julian overcame this strenuous beginning and graduated first in his class with Phi Beta Kappa honors. (6)
- In 1923, after several years of teaching chemistry at Fisk University, Julian accepted a scholarship from Harvard University to pursue his master's degree. (6)
- Harvard University refused to admit Julian to into their doctoral program, likely because he was African American. (6)
- Percy Lavon Julian spent several years teaching at black colleges until he was given the opportunity to pursue his doctorate. (6)
- The University of Vienna in Austria awarded Julian his Ph.D. in 1931. (6)
- Julian then returned to DePauw university continue his research. (6)

PROFESSIONAL LIFE

- After completion of his research at Depauw, Julian was hired by Glidden Company as a lab director. (6)
- Under employment at Glidden, Julian invented Aero-Foam, a product that uses soy protein to put out fire. (6)
- Aero- Foam was widely used in World War II and saved the lives of many soldiers. (8)
- Julian continued his research in the biomedical field and discovered how to synthesize the hormones progesterone, testosterone, and cortisone. (6)
- In 1953, Julian left Glidden Company and established his own laboratory, which he names Julian Laboratories. (6)
- In 1961, Julian Laboratories was sold and Percy Lavon Julian became one of the first black millionaires. (6)
- The remainder of Julian;s professional life was spent running the Julian Research Institute, a nonprofit organization which he founded in 1964. (6)

PERSONAL LIFE

- Julian met Anna Roselle while working at Howard University. The two married in 1935 and had two children. (6)

AWARDS AND RECOGNITION

- In 1973, Julian became the first black chemist elected to the National Academy of the Sciences. (6)
- Julian was elected to the National Inventors Hall of Fame in 1990. (6)
- In 1999, the American Chemical Society recognized Julian's synthesis of physostigmine as "one of the top 25 achievements in the history of American chemistry. (6)
- Several students trained by Julian were published in the *Journal of the American Chemical Society*. (6)

JULIAN'S CONTRIBUTIONS TO MEDICINAL CHEMISTRY

SYNTHESIS OF STEROID HORMONES

- Julian's synthesis of steroid hormones began with the isolation of geneserin. (7)
  - Geneserin is a companion alkaloid of physostigmine from the Calabar bean. (7)
- In acid- washed oil extracted from the beans during Julian's experiment, he discovered small crystals of the hydrate of stigmasterol. (7)
  - Sterols, such as stigmasteol, are composed of a four-ringed structure of carbon atoms. (7)
    - This carbon structure is found in steroid molecules, such as cholesterol and sex hormones. (7)
- During Julian's time at Glidden Company, he noticed that water seeping into a soybean oil tank resulted in a solid white material collecting at the bottom. (7)
  - Small traces of sterols in soybean oil were concentrated and isolated in the white solid. (7)
  - Julian recreated the incident to produce large quantities of sex hormones. (7)
  - Sex hormones synthesized by Julian include progesterone and testosterone. (7)
  - There hormones are widely used in prescription drugs today. (7)

WHAT IS AN OXINDOLE?

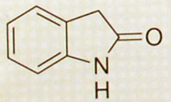


Image from: "2-Oxindole." Sigma-Aldrich. Sigma-Aldrich Co. LLC, n.d. Web. 30 Apr. 2017.

THE COMPLE SYNTHESIS OF PHYSOSTIGMINE

WHAT IS PHYSOSTIGMINE?

- Physostigmine is an alkaloid found in the Calabar bean. (7)
- This compound is used to treat glaucoma.
  - What is Glaucoma?
    - Glaucoma is a disorder in which eyeball pressure increases when the aqueous humor isn't drained properly. (7)
    - Glaucoma can lead to damage of the optic nerve and ever loss of vision. (7)
  - How does Physostigmine treat glaucoma?
    - Physostigmine promotes the drainage of the aqueous humor by easing the constriction of outflow channels. (7)

HOW DID JULIAN SYNTHESIZE PHYSOSTIGMINE?

- Julian and his assistant, Josef Pikl, synthesized the compound in 11 steps. (7)
- The synthesis took three years to complete and was reported in a series of papers published in the *Journal of the American Chemical Society*. (7)
- Starting from phenacetin, a pain relieving drug, the chemists worked toward the synthesis of d,l-eserthole. (7)
  - D comma L dash what?
    - D,l-eserthold is a "key intermediate compound two steps behind physostigmine" (7).
    - In other words, synthesis of d,l-eserthole would propel the chemists closer to the synthesis of physostigmine.
- Julian wrote in the *Journal of the American Chemical Society*:
  - "The determination of its constitution (physostigmine) was rendered particularly difficult since its peculiar chemical structure found no analog in any other plant products of known composition" (3).
  - "Thus it stood out the only naturally occurring derivative of 5-hydroxyindole" (3).
- In 1931, Julian and Pikl began experiments on the preparation of specific homoamines and homoacids (3).
  - They were especially concerned with derivatives in the oxindole series, since 5-hydroxyindole is a naturally occurring derivative of physostigmine. (3)
  - Julian and Pikl essentially perform a series of reactions that lead to the synthesis of a product physically and chemically identical to physostigmine. (3)

COMPETITION

- At Oxford University in England, a group of chemists working under Sir Robert Robinson were working toward the synthesis of physostigmine at the same time as Julian and Pikl. (7)
- Robinson reported his group's synthesis of d,l-eserthole. (7)
- "The physicochemical parameters of Robinson's d,l-eserthole were not in agreement with those of Julian and Pikl" (7).
- Julian was confident in his own synthetic strategy and wrote in his paper that Robinson was in error. (7)

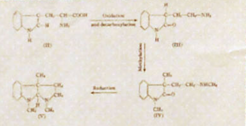
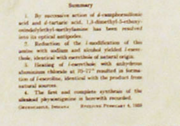


Image from: Julian, Percy L., and Pikl, Josef. "Studies in the Indole Series V. The Complete Synthesis of Physostigmine (eserine)." Journal of the American Chemical Society. Vol. 57, pp. 755-757.

JULIAN'S SYNOPSIS OF THE SYNTHESIS OF PHYSOSTIGMINE



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MEDICINAL CHEMISTRY

WHAT IS MEDICINAL CHEMISTRY?

- "Medicinal chemistry is a stimulating field as it links many scientific disciplines and allows for collaboration with other scientists in researching and developing new drugs" (4).
- Medicinal chemists apply their extensive background in chemistry to the process of synthesizing new drugs and improving current pharmaceutical processes. (4)
- Medicinal chemists are particularly concerned with:
  - New drug discoveries
  - Isolation of medicinal agents found in plants
  - Creation of new synthetic drug compounds (4)
- Sciences essential to the field of medicinal chemistry include biology, biochemistry, organic chemistry, pharmacology, and microbiology, and spectrometry. (4)(1)

BRANCHES OF MEDICINAL CHEMISTRY

1. Isolation and identification of compounds from natural sources

- "This branch entails a heavy component of analysis following the recovery of a previously unknown material from a plant or animal source that may have been experience stress under a specific set of conditions" (1).
- This material is analyzed to determine its exact molecular weight and fully characterize its physical and chemical properties. (1)
  - How is this done?
    - Infrared spectrometric analysis is used to determine the types of functional groups present in the material at the molecular level. (1)
    - Nuclear magnetic resonance spectrometry is used to determine the three dimensional orientations of carbon and hydrogen atoms. (1)
    - Mass spectrometry is used to determine the exact molecular mass of the material. (1)

2. Synthetic organic chemistry

- Primary focus of medicinal chemistry. (1)
- Various chemical reactions and the conditions under which these chemical reactions occur are used as a primary source for medicinal chemists. (1)
- Medicinal chemists use this knowledge to infer the basic steps for the synthesis of specific chemical compounds. (1)
- Failed reaction procedures lead to new research in synthetic methods. (1)
- Synthetic organic chemistry researchers strive to meet two goals:
  - "find a means of producing a specific molecule or part of a molecule cleanly and efficiently (without undesirable side products)" (1)
  - "prove the viability of a previously untried material in carrying out a specific type of reaction" (1)

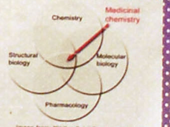

Image from: "Chilkur Balaji Pharmacy College." Chilkurbalajipharmacy.org. N.p., n.d. Web. 30 Apr. 2017.

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