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Perspective

A Hidden Life of Research

Charles Henry Turner's research on animal behavior remains relevant a century after his death, yet his name is largely absent from textbooks and history books.

Charles I. Abramson

One of three boxes in front of the honeybees contains a reward, if the bees can figure out which one. After a few tries, the bees learn to immediately go to the box with the pattern that contains the treat. But then the experimenter, Charles Henry Turner, changes which box holds the food, and the bees relearn where to go. In his makeshift laboratory at the high school where he taught biology, Turner performed 19 different careful and meticulous experiments for this one study, which showed that bees could learn using visual patterns. Turner published this study in 1911, in the middle of a remarkable scientific career that spanned from 1891 to 1923.

Turner had already done other bee experiments—including placing dishes of jam on outdoor tables at different meals to show that bees had a sense of time, and creating paper constructions in various shades to try to demonstrate that bees had color vision. He also studied any number of other insects—he created elaborate mazes for cockroaches, and he was the first to show behavioral conditioning in moths—as well as studied other organisms such as reptiles, birds, and plants. All of this research was done at a time when insects were believed to be mere automatons, only blindly responding to stimuli, without the ability to learn.

During Turner's lifetime, he published more than 70 papers, without the benefits of a university laboratory, funding, or graduate student support. In 1913, the editor of *Science* at the time, J. McKeen Cattell, stated at the annual meeting of the American Association for the Advancement of Science: "There is not a single mulatto who has done creditable scientific work." This blatantly racist claim was also highly ironic, as Turner had published twice in *Science* in 1892, first on avian brains and next on leaf production in grape vines (and also twice that same year in the *Journal of Comparative Neurology* on spider brains), then again in 1909 on snake feeding behavior—in all, he published 28 research papers before even completing his PhD in 1907. Despite publishing so prolifically, Turner was never able to secure an academic position, and he instead ended his career teaching at a high school, primarily because of the racism exemplified by Cattell's claim. But a century after his death, his work continues to prove how insightful and prescient he was in the field of the behavioral sciences.

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Charles Henry Turner was born two years after the end of the Civil War, and although he was able to complete his PhD in 1907, as well as publish more than 70 papers during his lifetime, he was unable to secure a permanent academic appointment largely because of racist hiring practices of the time.

Early Promise

Charles Henry Turner was born in Cincinnati two years after the end of the Civil War, on February 3, 1867. That year was auspicious in the history of African Americans: During that year, the Peabody Fund to promote African American education in the South was created; a law permitting African American males to vote in Washington, D.C. was enacted; and Howard University and Morehouse College were founded.

Turner's father, Thomas, was a custodian, and his mother, Addie, was a practical nurse. Both understood the importance of education, and they strongly supported Turner's early educational

QUICK TAKE

Despite publishing prolifically, Charles Henry Turner (1867–1923) was never granted a position in an academic institution and spent his career as a high school teacher.

Turner's experiments were inventive and carefully employed multiple controls and conditions, as well as creatively built equipment, to study insects and other animals.

A century after his death, Turner's insights into the sensory capabilities and learning behaviors of insects and other invertebrates remain insightful and relevant.



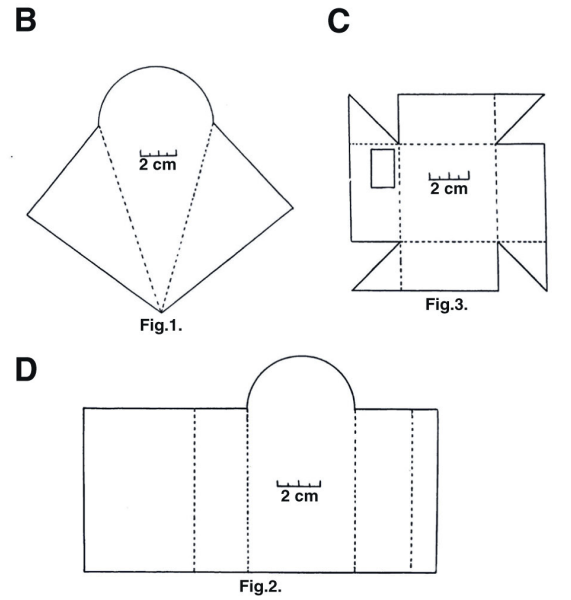





Luc Viatour; Katja Schulz; Len Worthington; jean-pierre Hamon; Mad Max; Wandering Mogwai; Jacy Lucier; Didier Descouens/Wikimedia Commons

Charles Henry Turner studied a wide range of invertebrates, notably honeybees, ants, and cockroaches. He also examined moths, spiders, caterpillars, antlions, mud dauber wasps, and a variety of other organisms. All of his research was conducted at a time when insects were thought to be mere automatons, reacting on instinct only. Today, Turner's work remains less recognized than his pioneering discoveries warrant.

M. Giurfa, et al. 2020. *Current Biology* 30:R1–R5.



In one of Turner's experiments, he created various structures from paper of different colors. At first, he only put a reward inside one red-paper shape. Then he used a different shape, in several colors, and showed that bees would go to the new shape in red paper first. Researchers later proved that bees cannot see red, although they can see other colors, so it is likely that the bees in Turner's experiment were using shading to learn which structures contained the reward. In his 1911 paper, Turner acknowledged that this short study could not control for shading versus color being the cue that the bees used to home in on the correct structure for a reward. (Designs from Turner's original paper, shown at B, C, and D, were recreated in A by M. Giurfa et al.)

endeavors. Their support is reflected in Turner becoming his class valedictorian at Woodard High School in Cincinnati.

Upon graduation, he enrolled in the University of Cincinnati in 1886. He earned his bachelor of science degree in biology in 1891, then his master's degree in biology in 1892; in 1907, he earned his doctorate in zoology from the University of Chicago, making him possibly the first African American awarded a PhD from that institution.

Particularly noteworthy is that Turner may have performed the first Pavlovian conditioning experiment on an invertebrate, when he conditioned a moth to anticipate an aversive stimulus in response to a whistle.

What happened to Turner next was later chronicled by W. E. B. Du Bois in 1929, who wrote:

> C. H. Turner, one of the great world authorities on insects, nearly entered the faculty of Chicago University; but the head professor who called him died, and his successor would not have a "Nigger," despite a reputation which was European; Turner died in a high school of neglect and overwork.

As a result of the racial prejudice he faced, Turner bounced around various jobs, including Clark College (now Clark Atlanta University) in Atlanta, College Hill High School in Cleveland, Tennessee, and Haines Normal and Industrial Institute in Augusta, Georgia. He also applied unsuccessfully for a job at the Tuskegee Institute, but Booker T. Washington did not have the funds to hire both Turner and George Washington Carver.

Turner and other African American scientists at the time faced great prejudice on a daily basis. One can only imagine the range of emotions Turner experienced when he daily encountered racist remarks both in person and in the academic literature, all while he was barred from academic appointment after academic appointment. Eventually, he gave up trying and took a position at Sumner High School in St. Louis in 1908 when he was 41 years old.

Turner's Broad Interests

Despite consistently moving from position to position and taking care of three small children after the death of his first wife, as well as his lack of resources, Turner's contributions to science were many and varied. His papers include observational studies, anatomical studies, studies of death feigning, investigations into insect learning, the development of experimental apparatuses, classical conditioning of moths, and civil rights. He also discovered new species and developed new methods of staining and dissecting. Many of his papers contained comparisons of several species.

His work was considered so important that he was recruited by John B. Watson, one of the founders of the behaviorist movement, to write yearly reviews of the literature on invertebrates. His work was also widely cited and appreciated by such respected behavioral scientists as Carl Warden, Margaret Washburn, Theodore C. Schneirla, and Edward L. Thorndike.

Particularly noteworthy is that Turner may have performed the first Pavlovian conditioning experiment on an invertebrate, when he conditioned a moth to anticipate an aversive stimulus in response to a whistle. He also was one of the first behavioral scientists to manipulate training variables—such as the number of experiences an animal receives, the time between those experiences, and the intensity of a stimulus presented to it—as well as to consider

the age of subjects as a variable. He also was one of the first scientists to recognize the importance of replicating experiments and of employing controls to solidify research results—indeed, he was able to show conclusively that honeybees have color and pattern vision by using controls now known to be important. Turner was also probably the first high school teacher to introduce a psychology class to his students.

Turner was one of the first scientists to suggest that insects may have emotions and are not "automatons" responding in rote ways to stimuli.

Turner was also one of the first scientists to suggest that insects may have emotions and are not "automatons," responding in rote ways to stimuli, as the literature of his time suggested. He ushered in a new view of insect behavior that is still being investigated today. As he wrote:

> There is much evidence that the responses of moths to stimuli are expressions of emotion. The fact that an insect does not respond to a sound is no sign that it does not hear it. The response depends upon whether or not the sound has a life significance.

And when he looked at ant behavior:

> It seems to me that in constructing the partial bridge, in removing the guards from the entrance and plugging it with cotton, and in closing the crack to the brood chamber, at first with trash piled on the outside and later with a wall built up from within, the ants have responded to stimuli, not as ends in themselves, but rather as means to ends. This would lift the act out of the realm of instinctive behavior into that of the practical judgment.

Paul Sableman/Wikimedia Commons/ CC 2.0

After Turner's death, three schools were named after him in the St. Louis area, all in a historically African American neighborhood known as "The Ville." One school, originally named Charles Henry Turner MEGA Magnet Middle School, and later Turner Middle School, was founded in 1999, and the building is landmarked. All three schools have now closed.

Although Turner is seldom recognized by the present-day scientific or civil-rights communities, he did receive some recognition in the past. In 1910, French naturalist Victor Cornetz named the exploratory circling movements of ants *tournoiement de Turner,* and in 1912 the African American magazine *The Crisis* named Turner one of its "Men of the Month." Following his death, Turner's contributions were recognized in the naming of several institutions, including the Charles Henry Turner Open Air School for Crippled Children established in 1925, Charles Henry Turner Middle Branch founded

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Turner made observations of the webs of spiders, noting how spiders would adapt the webs to fit odd shapes and corners, and how they would patch together repairs if the web was damaged. Turner wrote, "We may safely conclude that an instinctive impulse prompts gallery spiders to weave gallery webs, but the details of the construction are the products of intelligent action."

Nuttawat Pongpacharapun/Alamy Stock Photo

Bees gathered on a bowl of mashed fruit emulate an experiment that Turner conducted with jam. Initially, he set out dishes of jam at breakfast, lunch, and dinner, and bees would arrive at each time. Then he changed the conditions so that the jam was only set out at breakfast. Soon the bees would only appear at that time, demonstrating that the bees had some perception of time of day and could develop new patterns of behavior based on changing conditions.

in 1954, and Charles Henry Turner MEGA Magnet Middle School founded in 1999. These schools were all located in a historically African American section of St. Louis known as "The Ville," and all are now closed.

In 1962, Turner-Tanner Hall (now known as Tanner-Turner Hall) at Clark Atlanta College was named in his honor. In 2002, the Animal Behavior Society created an annual Charles H. Turner Poster Session and Travel Award for undergraduate presentations. And in 2023, the biology department of Columbia University in New York created the Charles H. Turner Award to recognize an outstanding postdoctoral student in the department.

Turner's academic advisor was apprehensive about including him in weekly laboratory meetings, so he asked his younger brother to poll the students, but there were no objections from anybody.

Turner has had some recognition amongst his peers, but he remains under-acknowledged for his work. Several articles and a book of collected papers with a comprehensive biography are available, but he is almost entirely absent in books on the history of biology, entomology, and psychology.

Turner, the Man

When Turner was accepted in an academic setting, he was well-liked and considered to be intelligent and dedicated. Charles Judson Herrick, a classmate of Turner's, commented:

> I think that the consensus of the class would be that Turner was its most able member. He published several neurological papers while still an undergraduate student of the University of Cincinnati, and one year, I believe, devoted himself to computation at the Cincinnati Observatory.

Herrick went on to say:

> Turner was an indefatigable worker, as shown by his papers on the brains of birds and habits of spiders, completed while still an undergraduate… and collaborated with my brother in the preparation of the monograph on this group of Crustacea, published in 1895.

In another instance, Herrick said of Turner:

> The man whom his classmates would probably have ranked as the most able member of the group, with high marks in all his courses, including a year of voluntary computation at the Observatory with Astronomer Porter, was C. H. Turner, a Negro. He was a shy, reticent fellow with a pleasing personality, the son of the janitor of a colored Baptist church in the city.

Charles Herrick was the younger brother of Clarence Herrick, an early and influential comparative psychologist who was Turner's advisor for his undergraduate and master's degrees. It was customary for Clarence Herrick to hold weekly laboratory meetings to discuss current research. As Turner was an African American and the University of Cincinnati was a "white institution," Herrick was apprehensive about including Turner in these weekly meetings, so he asked his younger brother to poll the students. The younger Herrick reported:

> There was no objection to the plan by anybody. On succeeding Fridays a long laboratory table was cleared, spread with a white cloth and we all sat around it discussing our scientific reports over tea and cakes, a beautiful demonstration of the cardinal principle that science recognizes no distinction of sex, creed, or race. Indeed, after Turner's graduation in 1891, my brother's successor had him appointed as an assistant in the department.

As a final illustration of Turner's dedication, consider a comment by University of Minnesota biologist Henry F. Nachtrieb in reference to a 500-page treatise on the Entomostraca of Minnesota, coauthored by Turner and his mentor Herrick:

> These gentlemen have given their services to the survey without charge, having asked for and received barely enough to cover their expenses.

A Voice for Civil Rights

Turner's scientific contributions are becoming a bit more known. However, little to nothing is ever reported about his civil rights work. Of his 71 papers, four directly concerned civil rights; the first appeared in 1897 and the most com-

prehensive in 1902. All his civil rights papers had a main focus on education. In his 1897 paper, Turner wrote:

> Biology should be taught in our schools, because it enables the Negro to know himself and his place in the economy of nature. A comparison of the anatomy, embryology, and psychology of man with the anatomy, embryology, and psychology of other living things enables man to discover his place in the economy of nature.

Turner's 1902 paper emphasizes that the racial animosity between "Blacks and Whites" can be resolved through education. He uses terms such as "white trash" and "vagrant Negros" and believes that prejudice can be examined through comparative psychology:

> Prejudice is older than this age. A comparative study of animal psychology teaches that all animals are prejudiced against animals unlike themselves, and the more unlike they are the greater the prejudice . . . Among men, however, dissimilarity of minds is a more potent factor in causing prejudice than unlikeness in physiognomy.

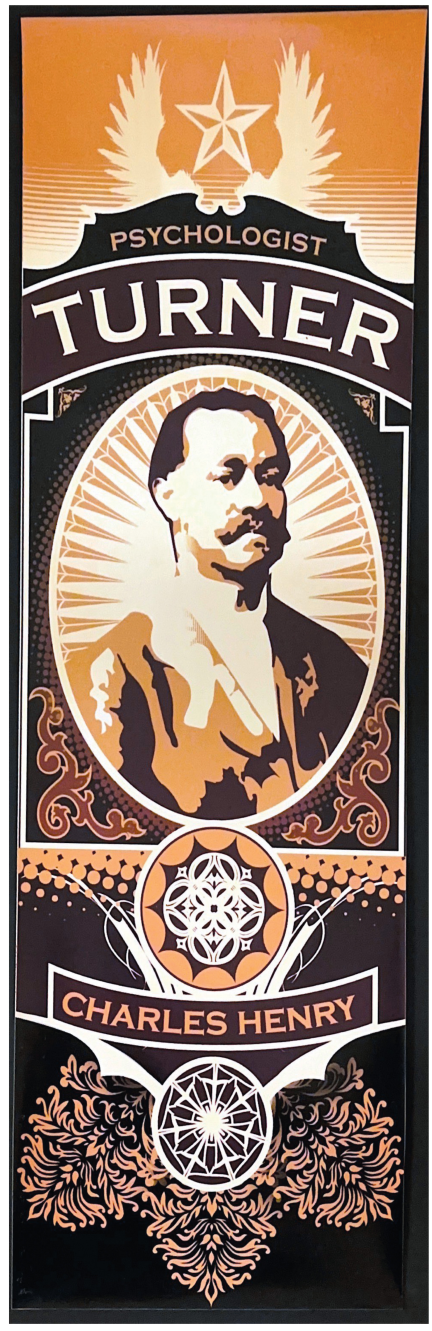
Turner goes on to discuss eight virtues that he expects could change the behavior of "white trash" and "vagrant Negroes": (1) manners of a gentleman, (2) culture homes, (3) business honesty, (4) thrift, (5) Christian morality, (6) the ability to do something well, (7) the ability to lead, and (8) love for justice and contempt for lawlessness.

Surprisingly, Turner's work is also seldom cited in journals devoted to African American history. Perhaps one reason is that his scientific work was not directly related to trials faced by African Americans in his time—although he wrote passionately about civil rights issues.

An Inspiring Life

For Turner's legacy to reach a broader range of people, one approach would be for the U.S. Postal Service to issue a commemorative stamp. Much like inclusion on currency for historical figures (such as the Sacagawea dollar coin) or in an online Google doodle (which is far-reaching but transient), stamps offer collectable, permanent recognition of figures of significance. Given the centenary of Turner's death, I would urge readers to join me in petitioning their representatives and the Postal Service to issue such a stamp. Such recognition is long overdue. Turner's story is truly a study of inspiration and should be shared with all as a source of motivation and pride.

Turner suffered from acute myocarditis and retired from Sumner High School in 1922 to live with his youngest son. Turner had named his son Darwin Romanes, after Charles Darwin and his collaborator George Romanes; Darwin became a family name that Turner's descendants still carry down to honor his role in research. On February 14, 1923, Turner died in Chicago, at 55 years old. His headstone simply has the epitaph "scientist." If Turner had simply been allowed to be a scientist during his time, who knows what additional work he might have contributed to entomology. As Martin D. Jenkins wrote in the *Journal of Negro Education* in 1940, "One can only speculate as to how great a scientist Dr. Turner might have been had the organization of our social order permitted the greatest development of his talent." Let's hope that in future textbooks, his work is more prominently recognized and remembered.



C. I. Abramson, et al. 2012.

The author and his students designed this poster, which has also been adapted as a postage stamp design, for the purpose of bringing wider public recognition to Charles Henry Turner and his scientific accomplishments.

Bibliography

Abramson, C. I. 2006. Charles Henry Turner: Pioneer of comparative psychology. In *Portraits of Pioneers in Psychology: Volume VI*, eds. A. Dewsbury, L. T. Benjamin, Jr., and M. Wertheimer, pp. 37–49. Washington, D.C.: American Psychological Association.

Abramson, C. I. 2009. A study in inspiration: Charles Henry Turner (1867–1923) and the investigation of insect behavior. *Annual Review of Entomology* 54:343–359.

Abramson, C. I., C. L. Fuller, and L. D. Jackson, eds. 2003. *Selected Papers and Biography of Charles Henry Turner (1867–1923), Pioneer of Comparative Animal Behavior Studies.* Lewiston, NY: Edwin Mellen.

Abramson, C. I., and C. W. Lack, eds. 2014. *Psychology Gone Astray: A Selection of Racist and Sexist Literature from Early Psychological Research*. Fareham, Hampshire, UK: Onus Books.

Abramson, C. I., and S. L. Long. 2012. The use of Zazzle to turn historically important psychologists and movements into U.S. postage stamps: The example of Charles Henry Turner. *Comprehensive Psychology* 1. DOI:10.2466/11.IT.1.5

Cadwallader, T. C. 1984. Neglected aspects of the evolution of American comparative and animal psychology. In *Behavioral Evolution and Integrative Levels: The T. C. Schneirla Conference Series*, eds. G. Greenberg and E. Tobach, pp. 15–48. Hillsdale, NJ: Lawrence Erlbaum Associates.

The Charles Henry Turner Website. https://psychology.okstate.edu/museum/turner/turnermain.html

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