

## George Papanicolaou (1883–1962): Discoverer of the Pap Smear

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### About the Author



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**Abstract** Born in 1883 in Kyme, Greece, George Papanicolaou obtained his medical degree in 1904 from the University of Athens and doctorate in Zoology in 1910 from the University of Munich. He migrated to the USA in 1913 and worked as an assistant at the Department of Anatomy in the Cornell Medical College. There, Papanicolaou examined vaginal smears under his microscope, charted the cyclic ovarian and uterine changes every day and harvested the oocytes at the appropriate time. He published his research on the cytologic patterns in guinea pigs in the American Journal of Anatomy in 1917. Eventually, he began taking similar scrapings from women and noticing malignant cells in smears taken from women with cancer. In 1928, his presentation on the topic at the Race Betterment Conference in Battle Creek, Michigan, was

greeted with skepticism as researchers felt that a biopsy and tissue examination was the only way to detect the disease. In 1939, he collaborated on a clinical study with Herbert F. Traut, MD, a gynecologic pathologist at Cornell, to validate the diagnostic potential of the vaginal smear and published their landmark paper in 1943 titled “Diagnosis of uterine cancer by the vaginal smear.” In 1954, Papanicolaou published the “Atlas of Exfoliative Cytology.”

George Nicholas Papanicolaou was a pioneer in cytopathology and creator of the Papanicolaou test or Pap smear. This revolutionized the early detection of cervical cancer and led to a 70% reduction in cervical cancer deaths.

**Keywords** Cervical cancer · Screening · Pap smear

## Introduction

George Papanicolaou (Dr. Pap) was a pioneer in cytopathology and inventor of the “Pap smear” for early detection of uterine cancer. He was a dedicated, modest and hardworking scientist, who immersed himself in the wonders of cytopathology. His 1954 publication *Atlas of Exfoliative Cytology* created the foundation of the modern cytopathology. In 1961, he established the Cancer Institute of Miami.

## Biography of a Biologist

### His Early Years

Born on May 13, 1883, in the town of Kimi on the island of Euboea, Greece, Papanicolaou was one of four children. He attended the University of Athens, majoring in music and the humanities. Under the influence of his physician father, Papanicolaou decided to pursue a career in medicine and graduated from the University of Athens in 1904 with top honors. He then did military service as an assistant surgeon and then returned to his hometown to care for leprosy patients for 2 years.

In 1910, Papanicolaou was awarded a Ph.D. in Zoology for his thesis, “Sex differentiation of the daphnia” from the University of Munich, Germany. He returned to Athens in 1910 and relocated to Monaco after his marriage at the Oceanographic Institute. In July 1911, he joined a marine research expedition in the Mediterranean Sea and Atlantic Ocean led by the Prince Albert of Monaco. During the First Balkan War in 1912, Papanicolaou returned to military service as a lieutenant in Greece’s medical corps, while in

the army, he met several American volunteers who told him about the many career opportunities in the USA.

### His Life’s Turning Point

In 1913, Papanicolaou emigrated to the USA and, after a year’s work as a rug salesman, violin player in a restaurant and a clerk in a Greek newspaper, he obtained entry into the New York University’s Pathology department and Cornell University medical college’s anatomy department [1–3].

In 1916, while studying sex chromosomes in guinea pigs, he observed that their reproductive cycles could be timed by examining smears of their vaginal secretions. In 1920, he ventured to study the cytology of the human reproductive system and in 1928, Papanicolaou reported that uterine cancer could be diagnosed by means of a vaginal smear [4]. The importance of his work was not recognized. In 1941, he published a paper on the diagnostic value of vaginal smears in carcinomas of the uterus and followed it up by publishing a book, 2 years later, in collaboration with a gynecological pathologist Dr. Herbert Traut (1894–1963), titled “Diagnosis of Uterine Cancer by the Vaginal Smear” [5, 6]. This landmark publication had a global impact and the Pap smear, or Pap test, became the gold standard in screening for cervical cancers. Widespread use of the test resulted in a significant 70% decline in the incidence of deaths due to cervical cancer (Fig. 1).

### His Pioneering Efforts

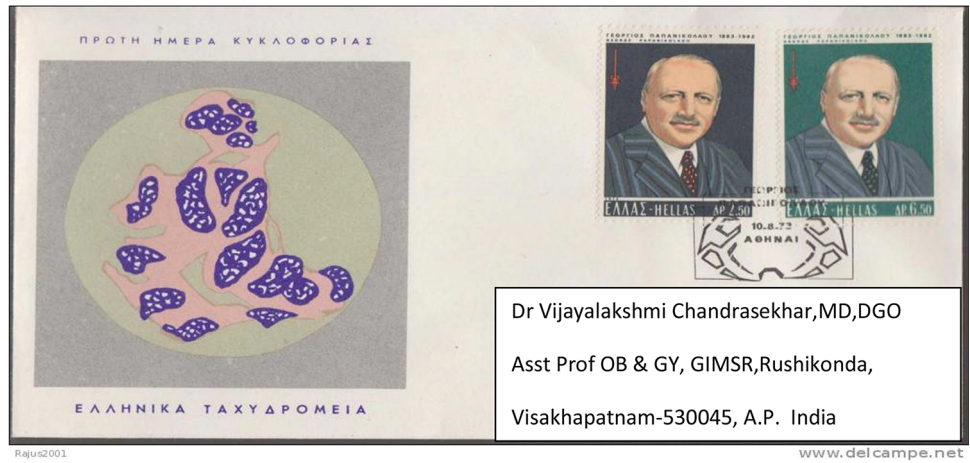
In 1951, Papanicolaou became an Emeritus Professor at the Cornell University Medical College. In 1954, he published another memorable work, the *Atlas of Exfoliative Cytology*. This laid the foundation of the modern medical specialty of cytopathology. In 1961, he relocated to develop and head the Cancer Institute of Miami (Fig. 2).

He died within three months of his arrival in Miami, suffering a fatal myocardial infarction on February 19, 1962. He was 78 years old.

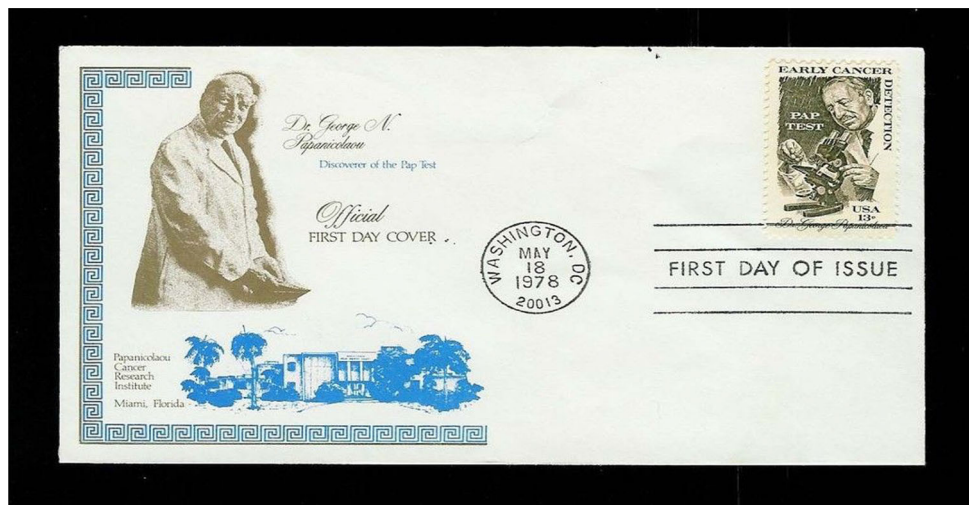
### His Good Work Recognized

Papanicolaou wrote more than 150 scientific articles and was the recipient of the Borden Award of the Association of American Medical Colleges (1940), the Amory Prize from the American Academy of Arts and Sciences (1947), the Albert Lasker Award for Clinical Medical Research from the American Public Health Association (1950) and the Medal of Honor from the American Cancer Society (1952). He was elected as an honorary Fellow of the Academy of Athens. In 1960, he was nominated for the Nobel Prize in Physiology and Medicine, and he was

**Fig. 1** A 1972 first day cover issued by Greece honoring Dr. Papanicolaou the legendary cytopathologist



**Fig. 2** The Miami Institute of Cancer also known as the Papanicolaou Cancer Research Institute

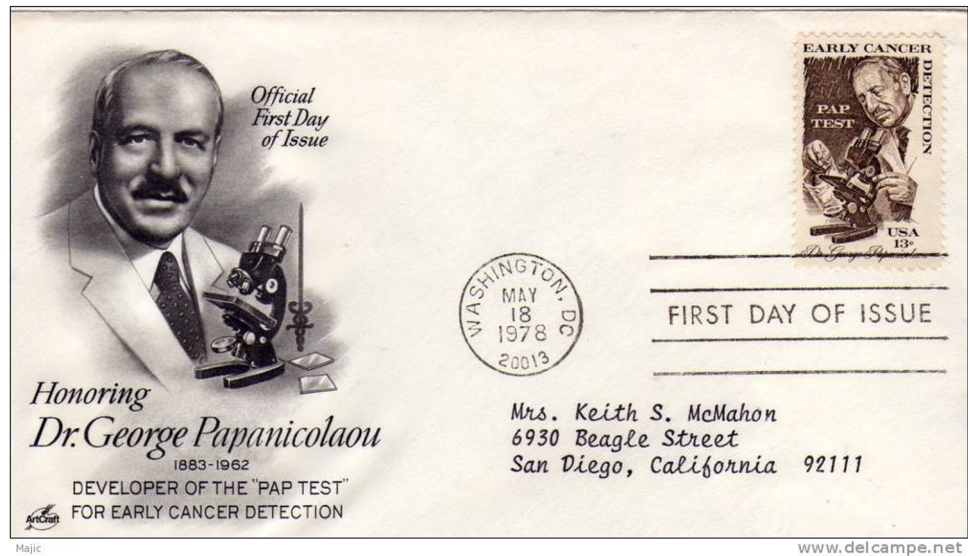


**Fig. 3** Greek 10,000 drachma currency note issued in honor of Dr. Papanicolaou





**Fig. 4** US Postal department first day cover on early cancer detection and the “Pap test”



awarded the United Nations Prize in 1962. His image was featured on the Greek 10,000 drachma currency note prior to its replacement by the euro and on various Greek stamps (Fig. 3). In 1978, the US Postal Service honored him with a commemorative 13-cent postage stamp (Fig. 4).

#### Compliance with Ethical Standards

**Conflict of interest** The authors Dr. Vijayalakshmi Chandrasekhar and Dr. Chandrasekhar Krishnamurti declare that they have no conflict of interest and have not received any research grants or honorarium, and no ethical issues are involved in preparation of the paper submitted.

**Ethical Standards** Permission has been obtained for copyrighted images in our historical article titled “George Papanicolaou (1883–1962): Discoverer of the Pap smear”.

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