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Contents:

Editorial.

Apologies for the slight delay in this issue of the Invisible light. Our front cover depicts the badge of the President of the British Society for the History of Medicine (BSHM). We had an excellent BSHM congress in Canterbury last summer with many great radiological contributions. As members of the BSHR we are members of the BSHM. The next congress is to be in Leeds in 2015 and I hope for an equal number of radiological presentations.

There are two interesting articles in this issue of the Invisible Light. One is a piece celebrating 50 years of PTA (can it really be that long?), and the other is an account of pioneer Greek female radiologists.

If you have any articles please send them to me for the next Invisible Light. I will be concentrating on books and DVDs in the history of radiology for the next issue. If you come across any books and films then please let me know, and write a short review if possible.

Best wishes
Adrian

Chairman, The International Society for the History of Radiology.

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Aunt Minnie Europe Articles.

Röntgen, Edison, et al: Early days of x-ray revisited. (August 12, 2013)
http://www.auntminnieeurope.com/index.aspx?sec=sup&sub=xra&pag=dis&ItemID=608549
When Wilhelm Conrad Röntgen discovered x-rays in 1895, he observed their effect on photographic glass and fluorescent salts. Certain crystalline salts such as barium platinocyanide or calcium tungstate show fluorescence when exposed to x-rays. These fluorescent effects could be observed by holding a coated screen in front of an object.

Robert Steiner embodied radiology's links with cardiology (September 17, 2013).
http://www.auntminnieeurope.com/index.aspx?sec=sup&sub=car&pag=dis&ItemID=608694
There has always been a close relationship between radiology and cardiology, and nothing shows this more than the life and work of Dr. Robert E. Steiner, who died peacefully on 12 September 2013.

John Macintyre and the world's first x-ray department (November 13, 2013)
http://www.auntminnieeurope.com/index.aspx?sec=sup&sub=xra&pag=dis&ItemID=608942
Glasgow is a wonderful place and well worth a visit. In 1990, it was designated a European City of Culture, and next year it will host the XX Commonwealth Games. The city is on the banks of the River Clyde, and is located in West Central Scotland. The second river of Glasgow is the Kelvin, and this name was used to create the title of Baron Kelvin, and is the SI unit of temperature.

Antoine Béclère and the origins of French radiology.
http://www.auntminnieeurope.com/index.aspx?sec=sup&sub=xra&pag=dis&ItemID=609131
I love France, and I have spent many pleasant weeks enjoying the French countryside and the wonderful wines. The country has made enormous contributions to world culture and science, and one of the greatest of her sons is the doctor and radiologist Antoine Béclère (1856-1939).

Old and Recent Books.

Induction Coils - How To Make, Use, And Repair Them - Including Ruhmkorff, Tesla, And Medical Coils, Roentgen, Radiography, Wireless Telegraphy, And Practical ... Information On Primary And Secondary Battery [Kindle Edition]
H. S. Norrie (Author)
Publisher: Obscure Press (16 April 2013)
Kindle Price: £7.71 includes VAT* & free wireless delivery via Amazon Whispernet
This book was originally published in 1901 is the Second Edition and has been thoroughly revised and partly rewritten. Information includes, coils for gas and automobile engines, medical coils and much more. Many of the earliest books, particularly those dating back to 1900s and before, are now extremely scarce and increasingly expensive. The publishers are republishing these classic works in affordable, high quality, modern editions, using the original artwork and text.

Tesla Coil (Tesla Technology Series) [Kindle Edition]
George Trinkaus (Author)
Kindle Price: £2.66 includes VAT* & free wireless delivery via Amazon Whispernet
Publisher: High Voltage Press; Third edition (1 Oct 2011)
Invented by Nikola Tesla back in 1891, the Tesla coil can boost power from a wall socket or battery to millions of high frequency volts.

This is described as the only systematic treatment of the Tesla coil for the electrical nonexpert.
Third edition, countless printings, still selling.

The Mystery of a New Kind of Rays: The Story of Wilhelm Conrad Roentgen and His Discovery of X-Rays [Kindle Edition]
Harold Berger (Author)
Kindle Purchase Price: £1.90
Publisher: CreateSpace Independent Publishing Platform (26 Sep 2012)
One of a growing number of Kindle books on radiology history.
"Roentgen's story is inspiring and unusual, in that he had to overcome many obstacles on his long journey to become a recognized scientist and teacher. Even after he had earned his doctorate in physics his unusual education path to an advanced degree presented problems."

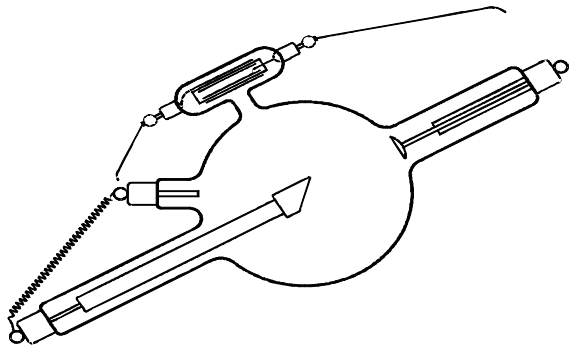
Interesting Web Sites.

A Time-Lapse Map of Every Nuclear Explosion Since 1945 - by Isao Hashimoto
http://www.youtube.com/watch?v=LLCF7vPanrY&feature=youtu.be

"2053" - This is the number of nuclear explosions conducted in various parts of the globe.*
"This piece of work is a bird's eye view of the history by scaling down a month length of time into one second. No letter is used for equal messaging to all viewers without language barrier. The blinking light, sound and the numbers on the world map show when, where and how many experiments each country have conducted. I created this work for the means of an interface to the people who are yet to know of the extremely grave, but present problem of the world.

Colour footage of atomic bomb tests in Nevada - Soldiers being exposed to high levels of radiation
http://www.youtube.com/watch?v=ZWSMoE3A5DI

Colour footage of atomic bomb tests with active duty military personnel at Camp Desert Rock, Nevada Test Site, Nevada. Shows soldiers in foxholes as nuclear detonation occurs nearby; light and shockwaves; blowing dust; soldiers climbing out of foxholes and running towards mushroom cloud. Some of this footage is familiar by virtue of having been seen in the film Atomic Cafe. Many soldiers who were present were exposed to high levels of radiation.



Celebrating 50 years of Angioplasty and its influence in modern day interventional radiology

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Introduction.
The groundbreaking research undertaken by Charles Dotter (1920-1985) over fifty years ago on peripheral percutaneous transluminal angioplasty has helped to save millions of lives and limbs[1], and has transformed many aspects of medical practice[2]. To commemorate the upcoming anniversary of this milestone, this article describes the historical development of angioplasty and includes influential contributors[3] to this field in the last fifty years. It also gives an exposition of Dotter's research and the impact that it has had on interventional radiology[4] and by extension medical practice today[5].

Angiography, setting the foundation.
As early as 1899 published research on fluoroscopy and radiography was available to the wider public[6]. This was made possible because of the dawn of the x-ray era, which enticed many into the field of cardiac radiology[6]. Numerous pioneers were responsible for work in this area[6].
In 1929 Werner Forssmann (1904-1979)[7] placed a ureteral catheter into his own right atrium[7] via his left basilic vein[8] with the use of a mirror and fluoroscopic control, and walked up a flight of stairs (whilst catheterised) to get an x-ray image[7]. His intention was to find a safer method for injecting drugs into the heart[8]. This was the first time cardiac catheterisation had ever been attempted[7]. For twelve years his experiment was subjected to severe negative criticism by his colleagues and ignored[8].
In 1941 a watershed moment occurred when Andre Cournand (1895 – 1988) demonstrated the safety aspects of human cardiac catheterisation[6]. With Dickinson Richards (1895 – 1973) and associates he employed the cardiac catheter as a diagnostic tool for the first time, an innovation that led to the Nobel Prize for medicine in 1956 which Cournand and Richards shared with Forssmann for their contributions to the cardiac catheter's development[8].

Dotter, the man and the birth of interventional radiology.
As Professor and Chair of The Department of Radiology at University Oregon[1], Nobel Prize nominee[9] Dotter felt that arteriosclerotic obstruction was far too common and significant and therefore warranted greater provision in therapy and treatment options then were available at the time[10]. He highlighted this in his paper in 1964 which described the technique. A quote from this paper's introduction, "*Expert vascular surgeons are reluctant to intervene in low femoral occlusions if tolerant intermittent claudication is the only resulting disability*"[10].This reflected the reluctance of medical practitioners to treat these common ailments, which resulted in gangrene and amputation secondary to femoropopliteal occlusions[10].
Angiocardiography was still in its infancy as Dotter entered his residency only 15 years after Forssmann's first right heart catheterisation[1].

Mechanical solutions and industrial help.
Dotter's dexterous attributes in mechanics helped him to overcome the technological limitations of the time. One significant barrier was that fluoroscopy based arterial imaging could only be conducted one snapshot at a time. Images were recorded on cassettes which needed to be changed manually in order to create a new image; this often resulted in gaps of seconds in exposure while the contrast was present in the coronary arteries[1]. This severely limited the usefulness of cardiac imaging to the medical practitioner. Dotter overcame this problem by developing an automatic x-ray roll film magazine in 1950, recording an image every half a second. This invention eventually became the basic template for x-ray tube design and grid control[1].

Figure 1: Charles Dotter examining an x-ray with Herbert Griswold and Kay Smith. *Image reproduced by permission from Oregon Health and Sciences University Digital library*

Despite Dotter's ingenuity in manipulating tools such as guitar strings and vinyl insulation[1], it was Bill Cook (1931-2011) who sustained Dotter's new ideas of catheter application and converted Dotter's sketch of two telescopic catheters to equipment which allowed him to perform the first ever transluminal angioplasty[1]. Cook went on to become the chief executive of a company that led the way in the in the manufacture of this type of equipment[1].

Transluminal Angioplasty – The Procedure.
On discontinuation of oral anticoagulants and under barbiturate sedation and anaesthesia (local for all but 2), Dotter introduced a catheter into the opposing femoral artery to the one that required treatment as he believed that so-called "*retrograde catheterisation*"[10] provided the best results[10]. Under fluoroscopic control (using the minimal amount of contrast to avoid associated arterial spasm) and after an initial injection of 2000 units of heparin into the entry site a 0.05 inch catheter was passed down the lumen and the stenosis until its tip had reached the lumen beyond. A radiopaque, 0.1 inch dilatable Teflon catheter was then inserted and passed over the stenotic region which subsequently enlarged the lumen[10]. Once dilating this catheter considerable traction was used to bring the catheter tip above the treated segment at which point the patient would acknowledge the adequate perfusion to that body part. It was then a simple matter of managing haemostasis manually via use of anticoagulation and the use of a non-constricting bandage on the puncture site. Dotter used a plethysmograph which allowed him to visually observe changes in blood pressure and pulse[10].

Dotter's Results.
After performing 15 procedures on 11 lower extremeties in nine patients, six extremeties improved to the point where amputation became unnecessary, two scheduled amputations went ahead and a third was delayed for three months. This was very promising as the majority of the patients had been rejected for surgery and were scheduled for amputation[10].
Results were measured by the return of measurable peripheral blood pressure and healing of the ischaemic limb. Symptoms were also relieved in those who had not benefitted as much as others from the procedure. Dotter was concerned with embolisation further on down the arterial path however he found no evidence, clinically or radiologically, that it had. Furthermore he commented that had the procedure caused this complication it would be "*overshadowed*"[10] by the benefits of the procedure overall[10].

Setbacks.
The procedure was not without its flaws. For example Dotter remarked on the little effect on total luminal obstruction at the site of obstruction, or proximal obliteration due to thrombus formation had on the outcome but he did notice the reduced improvement in the patient when taking the periatheromatous route as opposed to the "*lumen-to-lumen*"[10] transatheromatous route. He also stressed the use of a small amount of contrast when required to minimise pain and arterial spasm which was especially likely to happen with extraluminal injection[10].

Criticism in the West.
Dotter also repeated a similar process in 1967, this time on an 82 year old woman with popliteal artery stenosis. Despite these advances however he received criticism especially in the United States for several years. The criticism centred on Dotter's technique of employing a large shear force on the atheromatous plaque increasing the risk to the vessel and branching vessels alike[11].

Andreas Gruentzig, the next link.
Andreas Gruentzig (1939-1985) was born in Germany and made the next key advances in angioplasty. Despite the onset of war which forced him to relocate several times as a child he still managed to excel as a student graduating from medical school in 1964[12].
It was noted that when Gruentzig attended a talk on peripheral recanalisation using Dotter's technique, his senior at the time was quite upset that somebody would go in and "*attack*"[12] diseased arteries in this way and stated that he never wanted such a treatment to take place at the hospital[12].
Even so Gruentzig after observing the Dotter method was impressed by the patient's ability to walk without claudication after treatment and the improvement in ankle pressure. After an unsuccessful demonstration to 10 colleagues (the patient citing lower leg pain and Gruentzig's subsequent realisation that they had accidentally embolised the plaque into the popliteal artery!) he persisted to collect Dotter cases and follow up patients who had undergone the procedure[12]. It became clear to him that although the Dotter technique worked, he realised that in order to perform dilatation in other regions of the body a change in approach was needed. Dotter himself had previously arrived at the same conclusion[12].

The beginning of Balloon Angioplasty.
Gruentzig was interested in the idea of a balloon, no doubt inspired by previous work where a balloon had been placed in a catheter. He could not create a distensible part of the catheter that could generate enough force to open the lesion, a problem that would take him 2 years to solve. After trying numerous materials including rubber pieces, thread and glue he finally discovered polyvinyl chloride compounds with the aid of a retired chemist[12].
He also encountered other barriers such as balloon inflation problems and he was hampered by the need for a "*double lumen*"[12] which many factories were reluctant to manufacture. It was only with assistance did he create a double lumen catheter a year later that was available for use[12]. The first application of a double-lumen catheter on January 24th, 1975 was a success and it led to the first canine coronary artery dilation in September 24th, 1975 (following catheter size reduction)[12].

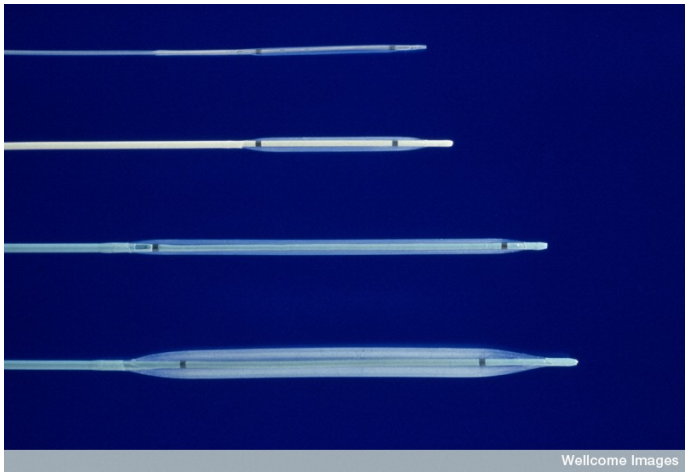

Figure 2: Angioplasty balloons used to restore perfusion in stenosed arteries in coronary and peripheral vascular disease. *Image reproduced by permission from Wellcome Images*

Figure 3: Andreas Gruentzig demonstrating a catheter.

Cited in: *http://www.lacrememagazine.co.uk/wp-content/uploads/2012/07/gruentzig_ptca.jpg*

Percutaneous transluminal coronary angioplasty (PTCA).
In 1979 Gruentzig published the findings of his study which he had conducted over an 18-month period. Gruentzig performed the percutaneous transluminal coronary angioplasty (PTCA) procedure on 50 patients[13]. The technique was found to be successful in 32 patients reducing stenosis from 84% to 34% ($P<0.001$) mean average and relieving coronary-pressure gradient from 58-19mm Hg mean ($P<0.001$)[13]. At the time Gruentzig postulated that 10-15% of those candidates for bypass surgery would have lesions that would be suitable for PTCA. He also stressed that a randomised trial would need to be performed to highlight the effectiveness of the procedure compared to surgical and medical approaches[13].

The 1980s onwards.
By 1984 angioplasty was ready to be tested against bypass surgery. After proposing the first randomised control trial to test its efficacy, Gruentzig unfortunately passed away before completing the study[12]. However significant developments in the 1980s had been set in motion before Gruentzig's passing. These included the use of lasers in Zurich which he had utilized in conjunction with the drilling machine. The drilling machine though never pursued due to the greater enticement of balloon catheters did reach animal model stage in 1972. It involved the use of a rotating drill with a speed of 3000 turns per minute to displace atheromatous material[12].

In 1987 the idea of directional atherectomy was developed. In that same year the first clinical stents were placed in USA. The idea of rotary ablation was also expressed but the treatment was only limited to the more calcified of plaques[12].

Intravascular ultrasound (IVUS[14]) introduced in 1989[15] proved to be a valuable addition[14] to angiography allowing further developments to be made in coronary artery disease, particularly in diagnosis and treatment[14]. Where angiography provided a two-dimensional dark shape, IVUS gave the medical practitioner more detailed information including actual plaque size to lumen area[14]. IVUS interpretation is acoustic echo dependent and comparative studies have shown disparity between angiography and IVUS to be greatest post mechanical intervention, where IVUS often detects disease in sites interpreted by angiography to be "*normal*"[14].

The 1990s were arguably the trial period of the procedures developed in the preceding decade[12]. Laser therapy initially gained a large following but due to high costs it made little long term impact[12].
Inspired by a talk given by Gruentzig in 1978 who described his technique for balloon angioplasty, Julio Palmaz (1945) felt that Gruentzig was overly concerned with the negative aspects[16]. Hooked on the idea of a vascular scaffold, Palmaz experimented with implantable metals in his garage[16]. After many setbacks including company rejection and mechanical problems[16], The F.D.A approved the Palmaz-schatz stent for use on patients in 1994[17] following the BENESTENT and STRESS trials[16].

In 2004, the drug-eluting stent in Boston[17] was approved. This sirolimus-eluting innovation seemed to finally address the problem of restenosis following Percutaneous coronary revascularisation by significantly reducing the risk by decreasing the frequency of revascularisation of the specific lesion from 16.6% with the original stent (P<0.001) to 4.1% with the drug-eluting stent (P<0.001)[18].

Angioplasty in practice.
Following on from the pioneering research of Dotter and Gruentzig, great strides have been made in the field of interventional treatment in relation to peripheral, coronary and carotid arteries despite the initial ridiculing and criticism of their research by their peers[8].
In the context of coronary angioplasty, it is estimated that globally up to 700,000 coronary angioplasties were performed in 1996[8], 1 million in 1997 and almost 2 million in 2001 making coronary angioplasty the most common intervention globally[17].
With the passage of time there have been significant technical developments including high pressure balloon material and improved guides that have raised the proficiency and performance of angioplasties[12].
Also further research has been undertaken to assess whether PTCA is a more effective intervention than bypass surgery. A meta-analysis conducted in 1995 found that overall there was no difference in prognosis between the two revascularisation techniques, however it was found that there was a higher rate of additional interventions for PTCA in the first year at 33.7% compared to 3.3% of patients randomised to Coronary artery bypass surgery. There was an increase of angina one year post-intervention within the PTCA group (RR 1.56 [1.30-1.88]) which after three years became less severe (RR 1.22 [0.99-1.54])[19].

The main barriers preventing coronary angioplasty procedures reaching their full potential include old and long occlusions and restenosis[8]. If these barriers can be overcome with further technological developments, for instance in pharmacological interventions and devices with innovations such as the drug-eluting stent[18] there may be a bright future for coronary angioplasties[8].

Dotter's influence and the future of interventional radiology.
Interventional radiology is seen by some as a link between a past of invasive intervention to a future of prophylaxis[20]. In order to progress along this developmental path it is essential to continue funding research training programmes to develop innovative changes[20]. Competition for boundaries exists with the other medical specialties such as cardiology and vascular surgery[20] and ultimately an ongoing evaluation of which intervention provides the most benefit to the patient will determine the direction of future research. With increased access to health care, health care reform and an aging population, it is predicted that the demand for interventional radiologists will increase. Moreover with the dramatic rate at which the new image-guided cancer therapies are developing such as focused ultrasound real-time MR-guided, there may be a widening role for interventional radiologists, particularly if these therapies become their responsibility[20].
In the past it was not uncommon for interventional radiologists to be referred to as "*Angiographers*"[4]. Associating management and evaluation with the role of an interventional radiologist was extremely rare until the advent of Dotter's pioneering work in 1963[4]. This highlights the role Dotter played in interventional radiology and why he is rightfully regarded as the "*Father of interventional radiology*"[1]. His work on angioplasty fifty years ago has formed the bedrock of future endeavours in this field[1]. In 2010 a global statement was made about the growing importance of interventional radiology by the leading bodies in the field, which perhaps serves to show the strength that this specialty is gaining[2]. Had radiologists simply limited themselves to a strictly technical diagnostic approach there was a strong high likelihood that they would have been severely hampered in competing with other medical specialties[4]. Arguably without Dotter's inspiration and drive to apply therapeutic intervention to what once was a diagnostic tool, the field of interventional radiology may never have existed.

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Pioneer Greek Female Radiologists (1895-1950): Modern Daughters of Asclepius?

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Abstract.
This article attempts to paint the "portraits" of the first Greek women radiologists with the backdrop of the social, economic, scientific and medical conditions in Greece at the end of the 19th and beginning of the 20th century.

Key-words: Radiology, history, women, scientist.

Introduction.
In English, the attending medical doctor is called a "physician". The root of the word is derived from the Greek word "φύσις - physis" meaning nature and indicates that the physician treats the physical attributes of a person as a whole and the imbalance in the harmony of the body's functions. Hippocrates, in 600 B.C., wrote: "The philosopher physician is equal to a god".1
In ancient Athens, it was forbidden by law for women to study medicine. The story of Agnodice is unique. She was an Athenian aristocrat who disguised herself as a man in order to study medicine, and then moved to Alexandria, and practiced alongside the famous physician Hierophilus. Upon returning to Athens, Agnodice practiced medicine, treating Athenian noblewomen, and made a significant contribution to an amendment in the law that would allow women to study medicine and practice it solely on women patients. 2,3

Women and the physical sciences.
Science throughout history has been dominated by men. This domination has been further emphasized by an intentional failure to report achievements of those few women who existed in the field of research and the physical sciences.
In the last decades of the 19th century and the initial decades of the 20th century, the women's liberation movement began in Europe and raised the issue of a woman's ability to engage in the sciences. It is worth mentioning that the Saint-Simonianism movement [France, beginning of the 19th century and whose main advocate was Claude Henri de Rouvroy, Comte de Saint-Simon (1760-1825)], set the foundations of faith in rational thinking, economic development and the progress of society as a whole. The movement also promoted religion, which gained it a wider following with both the French bourgeoisie and lay-men alike. Its followers and the movement's idealists claimed their allegiance to science, industry, a love of structure, the importance of setting up networks, and the advancement of urban civilization. In 1894, they organized the first conference on women and science in Paris. 4
The year of 2011 marks the 100th anniversary of Marie Skłodowska-Curie's Nobel prize in Chemistry and the United Nations declaration of 2011 as the International Year of Chemistry. This double anniversary shows that there are many significant women who have contributed to changing the world by creating solutions through their research and scientific work.
Since 1903 until today, although 516 Nobel prizes have been awarded in Science and Medicine, only 12 have gone to women. More specifically, in 1903, a Nobel prize in Physics was awarded to Marie Skłodowska-Curie (1867-1934), in 1911, a Nobel in Chemistry to Marie Skłodowska-Curie, in 1935, a Nobel in Chemistry to Irene Joliot-Curie (1897-1956), in 1947, a Nobel in Medicine to Gerty Theresa Cori (1896-1957), in 1963, a Nobel in Physics to Maria Goeppert Mayer (1906-1972), in 1964, a Nobel in Chemistry to Dorothy Crowfoot Hodgkin (1910-1994), in 1977, a Nobel in Medicine to Rosalyn Yalow (1921-2011), in 1983, a Nobel in Medicine to Barbara McClintock (1902-1992), in 1986, a Nobel in Medicine to Rita Levi-Montalcini (1909-), in 1988, a Nobel in Medicine to Gertrude B. Elion (1918-1999), in 1995, a Nobel in Medicine to Christiane Nüsslein-Volhard (1942-) and in 2004, a Nobel in Medicine to Linda B. Buck (1947-). 5
Based on the above numbers, are women scientists doomed to oblivion despite any contribution they make to the field of the physical sciences?

Women and science: the reality in Greece.
In Greece, the references to historical Greek female scientists are limited to Diotima [("Dios" is the ancient god Zeus, and "tima" means to honour, therefore, Diotima refers to honouring the god Zeus) who was a

priestess at the ancient oracle of Mantineia in Arcadia. She is mentioned as the only woman who took part in Plato's Symposium and as the woman who taught Socrates the mysteries of love being a passion and a motive to what is beautiful and real. Adept at Pythagorean arithmosophia (the apocryphal study of numbers), according to Xenophon, she was not inexperienced in the difficulties of understanding geometric theorems. Her name, nowadays, is indicative of philosophical, scientific and social inquiries and it is also indicative of action for equality between men and women)]. 6 Another female scientist is Theano [(a Greek mathematician and astronomer who was descended from the Thourians of Southern Italy and the daughter of the physician Vrontinos). She initially studied with and then went on to become Pythagoras' wife. She taught astronomy and mathematics in Croton and Samos. She supervised the spread of Pythagoras' teaching throughout Greece, as well as Egypt, and she is considered to be the most famous female astronomer and cosmologist in antiquity)]. 7 Last but not least is Hypatia (370-415 A.D.), a Greek neoplatonic philosopher, astronomer and mathematician who lived and worked in Alexandria, where she was murdered by a mob of fanatic Christians. 8 All three are historical figures verging between myth and reality.

We should bear in mind that the right to vote did not exist for women in modern Greece for quite some time. Women voted for the first time in municipal elections in 1956 and the first woman mayor elected was Maria Desylla on the island of Corfu. The right to vote in parliamentary elections was not granted to Greek women until 1952. The first Member of Parliament was Eleni Skoura, who was elected in Thessaloniki in 1953. It wasn't until 1975, with great delay, that the Hellenic Constitution declared women to be equal to men. 9 The first Greek woman to enter university was accepted by the National and Kapodistrian University of Athens in 1895. The first female lecturer at the National and Kapodistrian University of Athens was Aggeliki Panagiotatou in 1897. She then went on to become the first female professor in 1908 and the first female member of the Academy of Athens in 1950. 2 In 1910, Eleonora Zaimi-Fleming became the first female professor at the University of London. The Hellenic Nursing School, with a teaching staff comprising of both male and female doctors and nurses, was founded in 1894. 2 In 1942, the female students at the Medical School of the Aristotle University of Thessaloniki comprised 28% of the student body, while in 1955 the number had dropped to 11% (possibly due to depressed social conditions after the Second World War and the Greek Civil War). In 1991, the percentage reached 35%. The first female university student to be awarded a doctorate from the Aristotle University's Medical School in Thessaloniki was Maria Papageorgiou-Mathioudi in 1947. 10

In 1960, there were 4,976 physicians working in Athens, most practicing general medicine (34.8%) or pathology (17.8%). There were also 180 radiologists (3.7%). It should be noted that 56% of the radiologists practicing in Greece worked in Athens. 11

The first female radiologists in Greece.
This article presents pioneering Greek women radiologists in recognition of their historical importance as well as to describe their difficulties, achievements and finally their contribution to Radiology in Greece. These women, in addition to being medical professionals, were required by Greek society in the last decades of the 19th century and the initial decades of the 20th century to be good wives and mothers. These women worked and built a career at a time when society was conservative and was reluctant and sceptical to embrace new ideas, especially from medical professionals who were women.
The first steps in Radiology in Greece unfortunately coincided with some of the darkest, blood-stained moments in the history of the modern Greek nation. In 1887, Turkey drew Greece into war, in 1912-1913, the Balkan Wars broke out, followed by World War I, the military campaign in Asia Minor from 1919 to 1922 and World War II. In the history of the Peloponnesian War, Thucydides had described three reasons for nations to go to war: honour, fear or vested interests. WWII did not fit this model because it did not consist of a simple conflict between adversaries and none of the aforementioned three reasons were being contested. WWII was the most extreme and brutal outburst of insanity which, unfortunately, had been conjured up by the human mind.

At the end of WWII, Europe was in ruins, trying to pick up its pieces by shifting its focus to human ideals.
In Greece, the Civil War (1946-49) which broke out at the end of WWII, proved to be the worst conflict of the 20th century that the Greek nation had ever faced. It left Greece in ruins. The people were so impoverished by the war that they began to abandon provincial towns for city centers. The social, economic and political upheavals that followed reinforced the rudimentary women's movement urging women to gradually break free of the confines of their household and step out into the workforce. Especially upper class women gradually took on more "conventionally male" roles which, in many cases, required a university education, while, some bolder women with dynamic personalities and strong will did not hesitate to compete against their male counterparts and to boldly adopt ideas that were revolutionary for their time.

In 1947, although temporary, the Chair of Radiology and Physiotherapy was established at the National and Kapodistrian University of Athens and the following year Felix-Eftyhios Hart (1885-1954) was promoted to full Professor of Radiology there. 12
From 1947, therefore, physicians wishing to specialize in Radiology had the opportunity to remain in Greece instead of studying at European or American universities.
In the first half of the 20th century, it was a very bold undertaking for a woman, even for those of the upper class, to complete her studies in the predominantly male field of medicine.

It was considered even more incredible to continue post-graduate studies abroad, especially in a specialty which required excellent knowledge and use of complex machinery. One can only imagine the conditions faced by women upon returning to the Greek rural towns to practice medicine in their specialty. At the time, there was limited freedom of thought, prejudice, a fear of both new ideas and of the unknown which existed in the minds not only of the patients but also of others who worked in the field of medicine. All these factors surely served as serious obstacles for young female physicians.

Evangelia (Lia) Farmakidou.

The first Greek female radiologist, Evangelia (Lia) Farmakidou (1890-1982), was born in Athens at the close of the 19th century, in 1890. 13,14 Her parents, Pamfilos and Irene neé Stavrianopoulou originated from Domista, Karpenisi. The couple had three daughters, Evangelia, Margarita and Theodosia. On her father's side, they were related (second cousins) to the famous researcher Georgios Papanikolaou (1883-1962). Lia Farmakidou spent her school years at the Arsakeio and she graduated in 1907. She then enrolled in the Medical School of the National and Kapodistrian University of Athens from which she graduated with summa cum laud the same period that Greece was already involved in the 1st Balkan War. She obtained her license to practice medicine on the 9th of July 1913. On the 17th of July of the same year 1913, she was awarded a Doctoral Degree from the Medical School of the National and Kapodistrian University of Athens with magnum cum laud.

Shortly afterwards the 1st World War broke out with painful consequences for the peoples of Europe which culminated in a tremendous loss of human life. In this climate, in 1916, she went to Paris with the intended purpose of completing her education under the guidance of Professor Belot. There for the first time, she learned up close the innovation that medical science of the period had to demonstrate.
She initially came in contact and then was charmed by the new speciality of Radiology. The new speciality had already begun to be practiced upon casualties of war because of the ability of X-rays to provide precise localization of bullets and other military projectiles in the human body, something inconceivable up to then.

Fig. 1: Lia Farmakidou as an adolescent.

She was impressed by the possibilities of new technology to such a degree that this experience influenced all her later medical career and placed her amongst the giants in this pioneering new speciality. A dream but also an aim of her later medical career was the introduction of Radiology into the Greek medical practice but also simultaneously its acceptance in a wider Greek sphere. After her stay in Paris, she returned to Greece and offered her valuable services, as a newly graduated doctor, at the trauma care centre that operated at the time in the facility of the Marasleios Faculty of Athens. Her sister, Margarita, served with her as a volunteer nurse, although she was a schoolteacher by profession.
As an individual with particular concerns and vision, she understood from early on, already from the period of her stay in Paris, the horizons that the new specialty opened for medical science. Unfortunately during the period between World Wars, the only way of obtaining the required training for the specialty was to go abroad. Thus she managed, by saving the necessary resources, to enter the international medical

community. In 1925 she went and specialised in the Radiology at the University of Munich under the Professor Grashey.

Thus Lia Farmakidou returned specialised in Radiology and became the first woman radiologist in Greece. After her return from Munich, she opened a private radiological laboratory, in a privately-owned building at 13 Gravias street, which she equipped with a radiology and radiotherapy unit from a well-known German supplier. She was a member of the Hellenic Federation of University Women and as such she represented Greece in 1932 at the 6th Conference of the International Federation of University Women (IFUW) which was organized by the International Federation of University Women in Edinburgh Scotland. The Conference, with President the Professor of Physiology from the University of London, Winifred C. Cullis, took place at the George Watson Ladies College. 15

Her love for her speciality, her continuous contacts with competent radiologists of the period and their common vision for Radiology led to the foundation of the Hellenic Radiological Society in 1933. Lia Farmakidou was one from the twenty founding members of Hellenic Radiological Society, as they are entered in the proceeding of the Society, in alphabetical order: Dimitrios Vasileidis, Evangelos Vidalis, Andreas Georgakopoulos, Isidoros Gounaris, Panagiotis Grigoratos, Antonios Throuvalas, Christos Kalantidis, Manos Karzis, M. Kontopoulos, Georgios Kratsas, Micheal Kyniras, Athanassios Lampadaridis, Panagiotis Lapatsanis, Joseph Kop, Stephanos Petroheilos, P. (Takis) Prapopoulos, Konstantinos Tsaggaris, Vagias Tsarouhas, Evangelia (Lia) Farmakidou and Felix- Eftyhios Hart. 16

As a member of the Hellenic Radiological Society, she fought, for the recognition of the speciality in Greece, as well as for the creation of the first Chair of Radiology at the Medical School of the National and Kapodistrian University of Athens. She was elected curator of the library following elections at the first Board of Directors meeting of the Hellenic Radiology Society which took place on the 25th of September 1933, at 3 Massalia street, Athens under the supervision of the first chairman of the Society, Dimitrios Vasileidis. Then she was elected special secretary following elections of the second Hellenic Radiology Society Board of Directors meeting which took place, on the 31st of January 1939, in the offices of the Medical Association of Athens, at 18 Panepistimiou Street. She was also elected curator of the library in the third Board of Directors meeting of the Hellenic Radiology Society following elections which took place, on the 13th of May 1945 in the offices of Medical Association of Athens, at 18 Panepistimiou Street. Finally, she was elected adviser to the Board of Directors of the Hellenic Radiology Society following elections which took place on the 18th of January 1955 in the central amphitheatre of the University of Athens.
During the decade of 1950, she moved her radiological laboratory to the ground floor of a two storey privately-owned building at 22 Mavromihali Street (tel. 34-544). At that time, she turned her attention toward and dealt particularly with the use of radiotherapy in the treatment of skin diseases and then with aesthetics.

This woman was successful during a time when the speciality was male-dominated; alone in conclaves of Radiology in Greece, she became widely known for her knowledge, her scientific training and her successful diagnoses, inspiring the respect and esteem of her colleagues. She was a physician who was pioneering and continually sought out new innovation. She was a scientist with an open mind, a free spirit and a liberal, with open horizons of thought, multitalented, honest with an independent personality, very social and with artistic sensitivities. She dedicated sufficient free time to music and played piano. No single one of these virtues is so rare in itself. Rare is their combination, and this combination is that which finally forges the virtue of a person.

As a member of the Hellenic Federation of University Women, in 1963, she conceived and organised the unveiling of the statue of the heroine Lela Karagianni, an important resistance fighter from the WWII. The content of a letter with protocol number 948 from the 27th of June 1963 from the Association of Greek Women Scientists is characteristic:

> "Dear Miss Farmakidou
> The Board of Directors wishes to extend to you its deepest thanks for the work that you performed as Chairman of the Organisational Committee, namely the organisation of the unveiling ceremony for the heroine Lela Karagianni.
> The presence of Princess Irene as the representative of our King, the official Authorities of the State, Representatives of the Government, Parliament, Armed Forces, the Mayor of Athens, representatives of Institutions of Higher Education, the politicians of the country, Women's Associations, etc. provided the highest honour to the memory of the heroine, as well as to the Association of Greek Women Scientists, whose work was made known to the Greek nation.
> Dear Miss Farmakidou the Board of Directors wishes to congratulate you for the idea you gave birth to and brought to fruition, giving to the Federation, and to the Board of Directors under the presidency of Mrs. Georgakopoulou, the honour of its realisation".

During her scientific career she gave interviews in scientific journals and in the daily press, as well as a sufficient number of lectures in the "Parnassos" Literary Association.
Lia Farmakidou spoke French, English and German fluently. At a relatively advanced age she decided to learn Italian and quickly enough she spoke it satisfactorily. She was never remiss in keeping abreast of current medical events and continually followed developments in Radiology, mainly in French and German scientific books and journals. She communicated frequently and exchanged views with her colleagues abroad, mainly from Germany, friends from the period when she lived and trained in Munich. In

1940 she co-authored a book with the title: "Aesthetics - Medical Science", that was published in Athens by the G. A. Kasimi and Son publishing house. She corresponded very often with her famous cousin Georgios Papanikolaou, exchanging information, but also medical ideas and problems.

The outcome of her marriage with Admiral Dravilas which took place during the 1940's was characteristic of her independent nature. The marriage was destined to last only five months, because as she stated herself, it seemed to her very boring and stressful to cohabitate, and to be subjected to the daily peculiarities of another person even if he was her husband.

In the last years of her life she still remained active, full of energy and lively, disproportionate to her advanced age. Her age did not limit her to the narrow confines of her house, she, as in earlier times, sought out pleasant company and intellectual discussions. Fortunately for her, she had the good fortune to always be surrounded by beloved relatives and faithful friends. Not having borne children, in the last days of her life she adopted her beloved nephew, son of her sister Margarita, the internationally renowned director and screen writer Ermolaos Velopoulos (1930-2002). She died in Athens on the 10th of November 1982, after a long and full life, at the age of 92.

Ekaterini Adamaki-Kakaviatou.
Evangelia (Lia) Farmakidou was followed many years later by Ekaterini Adamaki-Kakaviatou (1913-2007), who was the first woman, acquired the title of Radiology in Greece. 17 She was born in Sitia, Crete in 1913. Her parents, the merchant Ioannis and Victoria, neé Sfakiotaki, had three daughters, Maria, Terpsihori and Ekaterini. Her family took active part in the social and political life of Crete and her grandfather, Aristeidis Sfakiotakis, had been a Member of Parliament of the Cretan State.

Fig. 2: Ekaterini Adamaki-Kakaviatou, fourth from the left, in the Anatomy Laboratory of the Medical School of the National and Kapodistrian University of Athens.

After the completion of her basic education in her birthplace, she enrolled and graduated from the Medical School of the National and Kapodistrian University of Athens. Still a medical student, in 1935, she accepted a marriage proposal and married her Internist colleague, Dimosthenis Kakaviatos, who at the time was a physician in the Special Disease Clinic of the University of Athens.
During the WWII and the German Occupation she provided her medical services to the Emergency Treatment Shelter. The specialty of Radiology kindled her interest from the beginning. As a result, after her graduation, she trained in Radiology and Radiotherapy, initially at the "Agios Savvas" Oncology Institute and afterwards in the Radiology Department of "Evangelismos" Hospital close to Apostolos Giannakopoulos, who was later destined to become the 2nd Professor of Radiology at the National and Kapodistrian University of Athens and the Reader Isidoros Gounaris. It is noteworthy that Ekaterini Adamaki belonged to the first generation of doctors that was given the possibility of specialising in Radiology in Greece, without having to resort to going abroad for this aim. She belonged to the generation that saw the establishment, although temporary, of the Chair of Radiology and Physiotherapy at the National and Kapodistrian University Athens in 1947. Ekaterini Adamaki gave her own colour to the varied mosaic of the history of Greek Radiology, as she was the first woman radiologist that specialised and obtained her speciality in Greece.
According to our information, during the 1950's she maintained a radiological laboratory in her husband's private clinic "Agios Nicolaos" at 32 Amalia street (telephone: 30-805). Her radiological laboratory, in addition to the radiological unit, was equipped with a unit for micro-x-rays and cauterization. She later worked in the radiology laboratory of the "Evangelistria", the private clinic of Georgiadis.
Characteristic of her love for her speciality was the fact that she was able to save, by buying, and then restore and maintain in excellent condition, a rare portable radiological unit which had been used by the

Greek army during the Balkan wars of 1912-13. This particular unit was never installed or used in her surgery. Her interest was that of a collector and she managed to preserve it completely functional and in exceptional condition.

In 1962 her beloved spouse died. This event marked her professional career. After the death of her husband, she was forced prematurely and permanently to interrupt her practice of the medical profession in order to devote herself to the upbringing of her two children, Nikolaos, today a doctor of Surgical Endocrinology, and Urania, a Microbiologist and the Director of the Microbiological Laboratory of the "Mitera" Hospital as well as the wife of Professor of Gynaecology Georgios Kreatsas.
She spoke French fluently. Ekaterini Adamaki-Kakaviatou died in Athens on the 19th of January 2007, at the age of 94.

Electra Antypa-Spiliopoulou.
Electra Antypa-Spiliopoulou (1914) specialized in Radiology in Greece and she was the first female director of a radiology department in a hospital in rural Greece. 18 She was born in Piraeus in 1914. She was the youngest of the four children of merchant Gerasimos Antypas and Aggeliki née Kariofyli.
She completed her basic education in Piraeus and in 1930, in age of barely 16 years, was registered in the Medical School of the National and Kapodistrian University of Athens. While she was still studying in the Medical School, she met her colleague Theodoros Spiliopoulos. Their meeting ended in marriage in 1936. After her graduation, she began her specialisation in Microbiology in the "Evangelismos" Hospital, following the example of her husband who also was specialised in the Microbiology in the same Hospital. Then Electra Antypa, captivated by the horizons that the new speciality of Radiology opened, decided to proceed to another specialty, this time in the Radiology, which she also acquired at the "Evangelismos" Hospital.

Fig. 3: Electra Antypa-Spiliopoulou.

The years that followed were unfortunately difficult, the WWII and the German Occupation marked their generation. With the entry of the Germans into Athens, they left and settled in Aegio, her husband's birthplace. They returned to Athens in 1944, when she was hired and practiced her speciality in a familiar place, in "Evangelismos" Hospital, close to old dear colleagues and teachers. In 1952 they decided to abandon the capital for the second time and they continued to practice medicine in Aegio.
In 1952 they were in Aegio, she with private radiology laboratory, as well as a microbiological laboratory, on Petmeza Street. During this period, the population of Aegio had already reached 19,892 residents and the city had sufficient large industrial plants, such as paper-making factories, paper-industry plants and processing plants for grape, oil and citrus fruit. It is noteworthy that the harbour of the city had developed into one of the most major in the country with enviable export movement, mainly citrus fruits, grapes, oil, wines and olive oil.
At the same time as their starting private practice, both were named for positions at the Public Hospital of Aegio. Electra Antypa - Spiliopoulou was named the first Director of the Radiology Department of the Public Hospital of Aegio. The years passed and changing needs forced the transfer of their private laboratories to a new location, therefore they were re-established at 24 Despotopoulou street. She continued to offer her services to both the Public Hospital, as well as her private practice, and specifically for 30 years, until 1982, when she retired.

In 1972 her beloved husband died. They had two daughters, Iris, today an Assistant Professor of Microbiology at the Medical School of the University of Patras and the Miranda, an architect with a private office in Athens.

Mary Kyriakakou-Paraskevopoulou.
Mary Kyriakakou-Paraskevopoulou (1919-1988) was the first woman director of a Radiology department in a hospital in Piraeus. 19 She was born in Piraeus in 1919. She was the last of five children of Anastasios Kyriakakos, from Zelina (later Melitini), Laconia, and Polyxeni née Moira from Niata, Laconia.

Fig. 4: Mary Kyriakakou-Paraskevopoulou.

She completed her basic education in her birthplace and then, in 1937, she moved to Paris, where she registered in the Medical School of the University of Paris. Unfortunately, with the declaration of the WWII, she was forced to return to Greece, having completed in July of 1939 the preparatory portion and the first year of Medical School. She transferred to the Medical School of the National and Kapodistrian University of Athens from where she graduated in 1946.

What actually however prompted her to make the choice of speciality in Radiology? The important thing in our life is that we recognize in time the profession that suits in our temperament and that encourages us to excel in: "He who accepts his destiny, the gods lead, he who denies his destiny the gods drag". Mary Kyriakakou knew from early on what her destiny was, what pushed her towards the speciality of Radiology was nothing other than the extensive scientific horizons that Radiology offered.
The next year, in 1947, she returned to her beloved Paris, where she was trained in Radiology initially in the hospitals Broussai and Laennek and then in the Fondation Curie under the guidance of Professor Baclesse, from May of 1947 until July of 1948. At the same time, she prepared intensively for the acquisition of the Certificate in Radiology, Radiotherapy and Electrotherapy. It is characteristic that at that time, the use of physical modalities and the Electrotherapy constituted an integral but also equally important chapter in Radiology. With the deposition and evaluation of important scientific work, as was expected, she acquired the title of "Assistante" at the Medical School of the University of Paris.

Now as a specialised radiologist returned in July 1948, she moved to the U.S. where she worked initially at the New York Hospital, then at the Memorial Hospital N. Y. close to Dr. Sherman and in the Mayo Clinic in Minnesota under the supervision of Professors Desgrer and Ledounlebard. During her stay in the U.S. and before her final return in Greece, she was offered a position as Director of the Radiology laboratory in a hospital in Montana, which she refused.

In 1950 she returned to Greece, a specialist in Radiology, Radiotherapy and Electrotherapy. She practised initially privately in Piraeus, at the "Asklipios" Clinic at 57 King Konstantinos street (telephone: 43-566). The "Asklipios" Clinic belonged to the brother of Georgios Kyriakakos, who had specialised in France as a Surgeon - Gynaecologist and who was later mayor of Piraeus during the periods 1964-67 and 1978-82.

The radiology laboratory of the Clinic was equipped with the first radiological unit from General Electric that was placed in a private laboratory in Greece.
In 1951-52 she moved her equipment and opened a private radiology laboratory at 47 Veranzerou street (tel. 52-867), then again in 1959 to 46 Patision Street and then, in 1969, to 38 Didotou street.
In December 1950, she undertook duties as Director of the Radiology Department of the General Public Hospital of Nikaia-Pireaus, the former Queen Freideriki Hospital. Thus the Mary Kyriakakou, at the age of barely 31, became the first woman radiologist that occupied the position of Director in a Hospital in Greece.
She was an extremely industrious and active individual and with a deep sense of duty. It was characteristic of her diligence that she often performed alone, without help from a technologist, intern or specialised colleague, a large number of fluoroscopic examinations per day. In 1961, on a trip to Paris that she had made for this purpose, she discovered sufficiently early that her health had been compromised due to radiation exposure. She directed deservedly the Radiology Department of the General Hospital of Piraeus for 19 years, until January 1969.
She maintained her private radiology laboratory until 1983, when she retired. She spoke fluent French and English and less well, Italian.
In 1952 she married Ioannis Paraskevopoulos, Director of the 2nd Clinic of Internal Medicine of the General Hospital of Piraeus. This union resulted in a son, Marios, today a Radiologist who practises homoeopathy simultaneously.
She lost her beloved husband in 1972. In 1986, she was diagnosed with breast cancer. She died in Athens in January 1988, at the age of 69.

Vasiliki Nikolaidou-Theofanopoulou.
Vasiliki Nikolaidou-Theofanopoulou (1924) was the first female paediatric radiologist in Greece. She was born in Athens in 1924. 20 Her parents, the Andronikos and Anna née Tzelali from Istanbul, had settled in Athens where they had three children, Maria, later a paediatrician and Director of Department of Cystic Fibrosis Disease at the "Agia Sophia" Children's Hospital, Vasiliki and Lazarus, a graduate of the Higher Commercial School.

Fig. 5: Vasiliki Nikolaidou-Theofanopoulou.

Vasiliki Nikolaidou completed her basic education in Athens. In 1942 she registered at the Medical School of the National and Kapodistrian University of Athens, and she graduated in 1950 and she decided to specialise in Radiology.

In 1950 she trained in Internal Medicine at the "Laiko" Hospital of Athens, in the Internal Medicine Clinic of the University Athens, under Professor Livieratos. The next year she began her specialisation in Radiology in the Radiological Department of the "Laiko" Hospital of Athens under Georgios Kratsas. Georgios Kratsas had founded the modern, for the time, Radiology "teaching faculty" in the "Laiko" Hospital of Athens and taught the speciality to a lot of interns who later would become directors of Radiology Departments in various hospitals in Greece, as well as University Professors.
Simultaneously, in 1951, was named assistant in the Radiological Department of the "Agia Sophia" Children's Hospital, under the Director Dimitrios Giannakos, where she worked from midday and

afterwards. In 1953 she specialised in Radiotherapy in the Radiotherapy Department of the "Laiko" Hospital under the Reader Isidoros Gounaris, for an interval of 18 months. In 1954 she specialised in Radiology in the Radiotherapy Department of the "Agios Savvas" Oncology Institute under Georgios Katrakis.
In 1955 she obtained the title of speciality. For all the duration of her speciality she was happy work as an unpaid assistant in the Radiological Department of the "Agia Sophia" Children's Hospital, a particularly important factor if we realize that at the time the economic condition of the majority of interns was tragic at the very least.

In 1956, after examinations by a committee of Ministry of Health she received the degree of Consultant. The next year, in 1957, she became a member of Greek Radiological Society. With the qualifications of Consultant and her specialisation with children she was named to the Radiological Department of the Children's Recovery and Rehabilitation Centre of Voula-Athens, where she examined children sick or recovering from poliomyelitis once per week.
In 1958 she was acclaimed summa cum laude doctor of Medical School National and Kapodistrian University of Athens, with her outstanding PhD thesis with the title "Contribution to the study of morphology of the large intestine during childhood" and dealt with the examination of 200 children from a few days to 15 years of age.
In 1959 she was named Director of the Radiology Department of the Children's Recovery and Rehabilitation Centre of the Paediatric Hospital of Penteli-Athens, a position which she held until 1962. Despite the position of Director which she held, every in the afternoon she watched without pay all the radiology examinations that were performed in the Radiological Department of the "Agia Sophia" Children's Hospital in Athens.

In 1962 she moved to London where for four months she trained in Paediatric Radiology in the Radiology Department in the Great Ormond Street Children's Hospital, under J. Sutcliffe.
At the end of 1962 she was named Consultant of Radiological Department of the "Agia Sophia" Children's Hospital, under the Director Dimitrios Giannakos. The same year she became a member of European Society of Paediatric Radiology, the congresses of which she attended uninterruptedly. It should be pointed out that the first Greek radiologist that dealt with Paediatric Radiology was Dimitrios Giannakos. In his steps and under his valuable teaching followed Vasiliki Nikolaidou, initially as an assistant, and then as a Consultant and Assistant Director, along with G. Tzamouranis, who, at the same time, was hired in the Radiological Department of the "P. and A. Kyriakou" Children's Hospital.
During the whole time of her work in the "Agia Sophia" Children's Hospital delivered, initially with D. Giannakos, and then alone, lectures in Radiology to medical students, paediatric interns and also to paediatricians. Courses and lectures in Paediatric Radiology followed that were intended mainly for Radiologists in Athens but also in the countryside. She translated numerous articles and books (mainly French and English) that dealt with the respiratory and the urogenital system, the bones, the determination of bone age in children and the potential of further height increase.
In 1978 she was promoted to Assistant Director and in 1981, after evaluation, she took the position of Director of the Radiology Department of the "Agia Sophia" Children's Hospital.

In 1990, along with their close collaborators of Efthymios Patsouras and Electra Nasi published the book "Radiological study of peptic system of the child" from cases that originated in the files of the department. As it was characteristically stressed by the writers in the preface: "This book was written in order to provide basic and special radiological knowledge to the intern and specialised Radiologist and Paediatrician mainly about the peptic system of children from the newborn to 14 years of age. The included topics deal with problems that we face daily in Paediatric Radiology at the "Agia Sophia" Children's Hospital and which are completely different from the problems of the peptic system in the adult". The book was met by laudatory comments of colleagues both radiologists and paediatricians.

Over the course of her 41 years of work she took part in countless Paediatric Radiology congresses, released innumerable reports in Greek and international Paediatric Radiology and Paediatric congresses and published scientific articles in the periodical Paediatric Radiology. She retired in 1992. One year later, in 1993, at the anniversary meeting for the 60 years from the foundation of the Hellenic Radiology Society, she was granted an honorary plaque for her contribution to Greek Radiology. In 1968 she married the businessman Georgios Theofanopoulos. From the marriage a girl, Marianna, was born. In 2002, she had the joy of seeing her daughter become a specialised Radiologist.

Evangelia Lelekou-Manthopoulou.
Evangelia Lelekou-Manthopoulou (1925) was the first woman director of a Radiotherapy department in a Greek hospital. 21 She was born in Hiliomodi, Korinthia on the 3rd of September 1925. She was one of four daughters of the teachers Stavros Lelekou and Helen Prevezanou. Her mother originated from Epirus, and more specifically from Preveza. Her father was a decathlon athlete, who participated in the 1906 Olympic Games. Her sister is the internationally renowned actress Irene Pappa.

She studied at the Medical School of the National and Kapodistrian University of Athens. She specialized initially in Athens and then in the Radiotherapy Department of the Anticancer Hospital of London "The Royal Cancer Hospital". She continued her training at the biennial postgraduate school of Oncology- Radiotherapy of the University of London, that at the time was affiliated with the "Meyerstein Institute of Radiotherapy" at the "Middlesex Hospital of London", close to the internationally renowned Professor of Radiotherapy and Chairman of International Committee of Atomic Energy, B. W. Windeyer.

Her passion for knowledge led her next to U.S. where she was educated initially at the University of Los Angeles, then at the "Center of Cancer and Allied Diseases" at Columbia University in New York and finally at the "Cox Cancer Hospital" in Boston. She worked at the "Regina Cancer Clinic" Oncology Centre in Saskatchewan, Canada, where, in 1951, cobalt radiotherapy was used for the first time worldwide. She followed the proceedings of Cancer Centres in Ottawa and Montreal.

Fig. 6: Evangelia Lelekou-Manthopoulou.

Upon her return to Greece she organised and directed in Athens the Anticancer Cobalt Centre in the "Alexandra" Maternity Hospital (former "Alexandra" General Hospital of Athens), where high voltage radiation was utilized for first time for cancer treatment. Based on a large number of experimental studies, in the "Alexandra" Maternity Hospital, she worked on her doctoral thesis, under the supervision of Professor Malamos, and finished with honours summa cum laude.

She also organised and directed, in Athens, at the Greek Oncology Institute, "Agios Savvas", the Radiotherapy Centre with a cobalt bomb (it was installed in 1960), Linear Accelerators and a 45,000,000 Volts (45 M.B.) Betatron (it was installed in 1959). It is worth noting that at the time only 19 similar Betatron units existed in the entire the world. During the duration of the seven year military dictatorship, she was removed from her position due to her democratic beliefs and was placed on suspension which lasted many months.
During the many years of her service in the Radiotherapy Centre of the Greek "Agios Savvas" Oncology Institute, she oversaw a large number of experimental protocols, multiple doctoral theses and readerships. For her service many times she was awarded honorary diplomas and medals from the Administrative Council of Anticancer Institute, but, also by the Surgical Division of the Hospital in 1995, in an event which was organised to honour her.

Evangelia Lelekou served as a member of the Greek Radiological Society, Greek Radiotherapy Company, Greek Oncology Society, Greek Medical Society, Chairman of Scientific Union of the "Agios Savvas" Hospital, member of Royal Society of Radiology and International Society of Radiology. During the period of her scientific activity she presented multiple lectures and organised a large number Greek and International Congresses.

For her scientific service to Greek Radiology she was granted honorary Diploma in 1993, in the framework of celebrations for the sixty years from the foundation of the Greek Radiological Society.
In 1951 she married Athanasios Manthopoulos, Director of the Urologic Clinic of the Greek "Agios Savvas" Oncology Institute. From their marriage, a son, Aiantas, was born. Today he numbers amongst the newer generation of talented actors in Greece.

Ioanna Keleki-Papantonakou.
Ioanna Keleki-Papantonakou (1926-2011) was the first woman director of a Radiology department in a hospital in Athens. 22 She was born in Athens on the 30th of September 1926. She was the daughter of Radiologist Stavros Kelekis and Smaro, née Ouzouni. One year after her birth, in 1927, her father opened the first radiological laboratory of Eastern Macedonia, in Drama.

She registered and studied at the Medical School of the National and Kapodistrian University of Athens, from 1945 until 1952.

From her high school years she dreamed of training in Radiology, something very natural if we understand that her family had a long tradition and already numbered two radiologists, who had been present since the dawn of the speciality in rural Greece. Her uncle, Anastasios Kelekis, specialised in Vienna, close to Dimitrios Kilaiditis and in 1925, with the brother of his wife, Theodoros Prousalis, opened radiological laboratory in Thessalonica, at 21 Agia Sofia street. Her father, Stavros Kelekis, who also specialised in Vienna, opened the first radiological laboratory in Drama in 1927, opposite the holy Mitropolis temple. In 1936, he moved his laboratory and founded the four floors "Keleki's Clinic" on Eleftheriou Venizelou street. Her father practised the speciality up to his retirement in 1972.

She believed unshakenly that Radiology should be the "centre" of medical science, and was vindicated for this belief with the swift development that the speciality witnessed in the next decades. She started her specialisation initially in "Evangelismos" Hospital during the period from 1952 until 1953, and continued her specialisation in the USA in Denver, George Town and at St. Louis University during the period from 1953 until 1956. During her stay at St. Louis University, she taught courses in Radiology, signs and symptoms and diseases of the heart to the students of the University. During the same period she acquired the Diploma of Radiology, as well as, the Medal of Isotopes of the American Board of Radiology. In 1956, she became a member of the American Cancer Society.

Fig. 7: Ioanna Keleki-Papantonakou.

She returned to Greece and from 1957 until 1977 worked as a Consultant in the Radiology Department of "Evangelismos" Hospital. In 1958 she was awarded the title of Doctor of the Medical School of the National and Kapodistrian University of Athens, with her excellent PhD thesis with the title "Congenital abnormalities of the skull". In 1979 Ioanna Keleki submitted her curriculum vitae and was named Director of Radiological Department of the KAT Hospital, a position which she deservedly held up to her retirement in 1993. During her 40 and more years of work, aside from the training of Radiology interns, she had been invited as an instructor and given multiple lectures in the Radiological Department of the University Athens, in the Radiological Department of University Crete but also in the Greek Radiology Society and the Radiology Society of Northern Greece.

She took part in a large number of international and of Greek Radiological Congresses, sometimes as Chairman of Round Tables and other times as an official, invited speaker. She served as a member of Greek Radiological Society, Greek Anticancer Society, founding member of European Society of Gastrointestinal Radiology (ESGAR) and later Emeritus member.
For her services to Greek Radiology, in 2000, she was awarded an honorary award from the Greek College of Radiologists in the framework of the 10th Inter-university Congress of Radiology which took place in

Alexandroupoli. Also, in 2006, she was given another award during a Congress of the European Society of Gastrointestinal Radiology (ESGAR).

In 1959 she married the lawyer Emmanuel Papantonakos and bore a girl, Angeliki.

Hera Florou-Alamani.
Hera Florou-Alamani (1927) was the first woman radiologist in Thessaly, Greece. She was born in Larissa in 1927. 23 He was the daughter of a General Practitioner, Nikolaos Floros, and Evdoxia, née Kyriakou. She completed her basic education in her birthplace at the 4th Public school and then at the Larissa Girls' Middle School (from 1932 until 1944). In 1946, with the end of German Occupation, she registered at the Medical School of the National and Kapodistrian University of Athens, from where she graduated in 1953. She specialised in Radiology and Radiotherapy, in Athens from 1953 until 1956. Initially she trained in Radiology and Radiotherapy in the "Evangelismos" Hospital and then she returned to the "Laiko" Hospital where she completed her training in Radiotherapy.

Fig. 8: Hera Florou-Alamani.

After the end of her specialisation, in 1959, she returned to her birthplace and opened a radiology laboratory at 13 Alexandros Panagoulis street. Larissa was one of the biggest cities in Greece and exhibited a rapid increase in population, going from 41,016 residents in the 1951 census, to 55.391 residents in the 1961 census. The city showed remarkable industrial growth, with 1,045 industrial plants, placing 6th amongst the industrial centres of Greece. Commerce also flourished in the city, with 278 wholesale shops and 808 retail shops, which made Larissa the 7th largest commercial centre in Greece.
It is worthy of note that Hera Florou was the first woman radiologist of not only the city of Larissa, but also of all Thessaly. In the city of her birth, she tried and progressively became established in the eyes of her colleagues and patients. The tools she used were the knowledge and experience that she had acquired in the big and particularly demanding hospitals of Athens. She maintained her private laboratory for 27 years, up to 1986, when she donated the radiology equipment and the tomograph, with which her laboratory was equipped, to the Greek Red Cross, thereby irrevocably terminating her private practice. The radiology table, as well as the tomograph, both manufactured by Siemens, were technologically modern for the time, fully functional and in excellent condition. For this donation, she was decorated by the Greek Red Cross.

In the same year, 1986, she submitted her curriculum vitae and was named Director of the Radiological Department of Larissa Regional General Hospital, a position she deservedly held up to her retirement in 1995. The duration of her scientific career was characterized by her hard work, her ethics and effectiveness but also for her compassion for the suffering of her fellow man, characteristics which made her particularly dear to so many patients, as well as to colleagues, independent of speciality.

In 1956 she married the electrical - mechanical engineer Orestis Alamanis and had two sons, Christos, today an Urologist in the Popular Hospital Athens, and Lecturer at the Medical School of the University of Athens and Nikolaos, a civil engineer with a private office in Larissa.

Dorothea Koumidou-Geroulakou.
Dorothea Koumidou-Geroulakou (1927) was the first radiologist in Sparta, Greece. She was born in Athens in 1927. 24 She was the daughter of the Cypriot tradesman Menelaos Koumidis and the philologist Liza née Askitopoulou from Athens. She completed her basic education in Athens and then registered at the Medical School of the National and Kapodistrian University of Athens, from where she graduated in 1952.

From the 1st of January up to the 31st of December 1953 she trained in Anaesthesiology in the Anaesthesiology Department of the "Laiko" Hospital of Athens, under the direction of Maria Tountalakovidou, for the purpose of giving her sufficient training to enable her to administer anaesthesia to the patients of her future husband, Surgeon Konstantinos Geroulakos.

Fig. 9: Dorothea Koumidou-Geroulakou.

From the 31st of December 1952 until the 28th February 1955 she specialised in Radiology, in the Radiology Department of the "Laiko" Hospital, under the direction of Georgios Kratsas and then from the 1st of March 1955 until the 30th of June 1956 in the Radiotherapy Department of same Hospital, under the direction of Isidoros Gounaris. She finished her specialisation in the Radiology Department of the "Agios Savvas" Oncology Institute, from the 1st of July until the 31st of December 1956, under the direction of Nikolaos Mihalakopoulos. Nikolaos Mihalakopoulos had served as chairman of the administrative council of the Greek Radiology Society after the elections of the 1st of March 1960 which were carried out in the amphitheatre of "Evangelismos" Hospital.
In 1955 she married Konstantinos Geroulakos. Two years after her marriage, and specifically on the 13 of March 1957, she obtained the title of speciality of Radiology.

From the end of 1957, with her husband, they settled in Sparta, the capital of Laconia. Sparta constituted the commercial and intellectual centre of Laconia, as well as the seat of the Prefecture and some decentralised services of various Ministries. According to the censuses of 1951 and 1961, the population of the city reached 7.900 and 10.412 residents respectively.

In the Sparta they worked in the "Geroulakos Clinic" that had been founded by her husband's elder brother, Dimitrios Geroulakos, an Obstetrician - Gynaecologist. She organised her radiological laboratory in the "Geroulakos Clinic", at number 93 Othonos - Amalia street, which aside from the in-house patients, also served a large number of referred out-patients and emergency cases. The laboratory was equipped with a radiological unit and tomograph from the American manufacturer Westinghouse. It was the second unit from this manufacturer that had been placed in Greece; the first had been placed in the Organisation of Social Security (IKA) in Athens. At the same time with radiology, because of her training in the anaesthesiology and the complete lack of a specialised anaesthetist in the prefecture of Laconia, during the decade 1958-1968, she administered anaesthesia in the operating theatre of the "Geroulakos Clinic".
From 1968 and up to her retirement, in 1994, she practised exclusively only the speciality of radiology.
She was elected elective Chairman of the Medical Association of Laconia, during the period 1990-1993. In conjunction with her medical activity she developed a wide cultural activity. She served from 1975 as vice-president of "Intellectual Hearth of Sparta", a cultural association that has been awarded by the Athens Academy.

From her retirement, in 1994, and up to the present she serves as Chairman of "Geroulakeion Scholarship Foundation". The institution is the legacy to the memory of Dimitrios Geroulakos and grants scholarships of six year duration to first year medical students from Laconia. It is worthy of note that up to the present 58 scholars have been subsidised, most of whom today practise medicine. The work of institution continues uninterrupted, accomplishing in practice the dreams that the late Dimitrios Geroulakos had for the young scholars of Laconia.
She had two children from her marriage, Georgios, today Professor of Vascular Surgery at the University of London and Chairman of Royal Vascular Surgery Society of London, and the Menelaos, an Engineer, with an office in Athens.

Sofia-Stamatella Grolliou-Soueref.
Sofia-Stamatella Grolliou-Soueref (1927) was the first radiologist in the islands of Ionian Archipelagos. 25 She was born on Corfu in 1927. She was the youngest child of army officer Christodoulos Grollios who originated in Lagada and Efterpi née Margariti from Margariti, which in the period between the World Wars belonged to the prefecture Ioannina, and later to the prefecture Thesprotia (which was created by the dictatorship of Ioannis Metaxas with the Mandatory Law 353 from 1936).
During the duration of the Macedonian Struggle, her father, still a small child had been used for the transport and exchange of useful information between the units of Pavlos Melas. As he said later himself, no one suspected what role a small child that wandered bare-foot through the villages of Macedonian countryside could play. Later, her father studied at the Vlahou School in Corfu. Her two elder brothers, Konstantinos, who was born in 1917, became an Academic and were elected Professor of Latin Literature at the Aristotelian University of Thessalonica, and Hectoras, born in 1925, followed the profession of their father.

Sofia-Stamatella Grolliou completed her basic education in the Corfu elementary school and at the Corfu Girl's High School and then, at the end of the German Occupation in 1946, registered at the Medical School of the National and Kapodistrian University of Athens, from where she graduated in 1954. From 1954 until 1958 she specialised in the Radiology in the Radiological Department of the "Laiko" Hospital of Athens under the supervision of Georgios Kratsas and in Radiotherapy in the Radiotherapy Department of same Hospital under the Reader Isidoros Gounaris.

Fig. 10: Sofia-Stamatella Grolliou-Soueref in her radiology laboratory.

What actually prompted a new doctor to choose Radiology as a specialty? A careful roaming of the by-ways of the history of Radiology in Greece will resolve all our queries. The first radiologists Sofia-Stamatella Grolliou's birthplace were Filoktitis Paramythiotis and Theodoros Stefanidis, close friends but also collaborators, both with studies abroad, who, in 1928, opened together the first radiological laboratory in Ionian islands, specifically in Corfu on the Nikolaos Mantzaros street. In December of same year, they published a 36 page book intended for the doctors of Corfu, which stated on the cover: "On the establishment of the Radiological and Electrophysiotherapy Laboratory of Doctors Filoktimon Paramythiotis and Theodoros Stefanidis. Including a concise review of illnesses, the diagnosis and treatment of which may be aided". They maintained their radiological laboratory for a decade, up to 1938, when Theodoros Stefanidis left Corfu, in order to explore the world of natural history and to leave a legacy to humanity in the form of a multitude scientific books, historical books as well as collections of poetry. From then on, the laboratory remained in the hands of Filoktitis Paramythiotis, who was the uncle of Sofia on her mother's side. 26
In 1958, Sophia-Stamatella Grolliou is in her birthplace took share the presmises and to collaborate in the radiological laboratory of her uncle, Filoktitis Paramythiotis, on the Nikolaos Mantzaros street. The city of Corfu, capital of the Province and also County of the same name, exerted an unusual attraction on the visitor with the characteristic Venetian style buildings and monuments. The city, by the end of the WWII, had suffered major reduction of population that was due on the one hand to the extermination of approximately 1,500 persons Jews by the Germans, and on the other to the abandonment of island by the Italians. According to the censuses of 1951 and 1961, the city numbered 27,431 and 26,991 residents respectively.
In 1962 the Filoktitis Paramythiotis retired and from then on she ran her radiological laboratory alone, which, in the mean time, she completely renovated and equipped with a modern, at the time, radiological unit constructional by the Watson Company, as well as instrument for cauterization. The use of physical modalities then constituted an integral part of the speciality. Characteristic of her professional career were her diagnostically acute, particularly detailed and extensive reports that won the respect of both colleagues and patients.

In 1959, one year after settling in Corfu, she married Dimitrios Soueref, a General Practitioner, also born in Corfu with distant roots from Malta. She bore two children, Antonis, today a civil engineer and Ekaterini, a psychologist.

She maintained her radiology laboratory for 34 years and retired in 1992.

Summary.
Female radiologists stood out with their exceptional personalities. They were bold, ambitious pioneers in their field, who faced hardships, prejudice and the difficult conditions at the end of the 19th century and the first half of the 20th in a nation ravaged by war and poverty that was trying to redefine itself and its goals.
History is a tool for future creativity. Therefore it is the duty of the medical community to honour these pioneering women to repay a debt of honour which can not be repaid in numbers or mathematical calculations. Such a debt can only be repaid by preserving things in writing for posterity.

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Illustrations
Fig. 1: Lia Farmakidou as an adolescent.
Fig. 2: Ekaterini Adamaki-Kakaviatou, fourth from the left, in the Anatomy Laboratory of the Medical School of the National and Kapodistrian University of Athens.
Fig. 3: Electra Antypa-Spiliopoulou.
Fig. 4: Mary Kyriakakou-Paraskevopoulou.
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Fig. 6: Evangelia Lelekou-Manthopoulou.
Fig. 7: Ioanna Keleki-Papantonakou.
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