Article

History of the Practice of Chemistry - a Maltese Perspective

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Summary: *The practice of chemistry has a long history on the Maltese Islands being closely related to the preparation of pharmaceutical substances. In line with events on the Continent, the initial investigations in non-pharmaceutical chemistry was closely linked to the practice of alchemy. Laboratory chemical investigations received as impetus during the nineteenth century with the introduction of medical chemical investigations. Academic curricula in non-medical chemistry were only established in the latter half of the twentieth century.*

Keywords: chemistry, alchemy, pharmacology

Introduction

Philosophical concepts in the make-up of matter started being entertained by the ancient Greeks during the fourth century B.C. Aristotle (384-322 BC) concluded that everything was made up five elements - earth, air, fire and water on Earth, and ether in the heavens. To Aristotle, the four traditional earthly elements were only aspects of a single matter affected by four fundamental qualities - hot, cold, fluid and dry. These qualities combined in pairs: cold and dry gave the element earth; cold and fluid gave water; hot and fluid gave air; hot and dry gave fire. While Aristotle's contemporary Democritus suggested that all matter was made of invisible particles which he called atoms, Aristotle's view of the composition of matter gained momentum and was extended to medical concepts by Galen (130-200 AD) with the identification of the four humours and four temperaments. The Medieval Italian monk Thomas Aquinas (1266-1273) in his attempt to compile the complete theory of the Christian doctrine adopted Aristotle's views thus giving a dogmatic seal to scientific concepts. These views on the make-up of matter led to practical science of the pre-17th century being practised by superstitious alchemists, while chemical substances were only utilised in the preparation of pharmaceutical substances. In spite of their limited views, the alchemists contributed towards several discoveries in chemistry. After the 16th century, the alchemists of Europe became divided into two groups. One group was composed of those who earnestly devoted themselves to the scientific discovery of new compounds and reactions. These scientists were the legitimate ancestors of modern chemistry. The other group took up the visionary, metaphysical side of the older alchemy and developed it into a practice based on imposture, necromancy, and fraud, from which the prevailing notion of alchemy is derived. It was only in the 17th century that Robert Boyle overturned many of the superstitious beliefs of alchemy. Boyle in The Sceptical Chemist (1661) outlined his ideas about the make-up of matter. He concluded that there were more than the four traditional elements. Furthermore matter was made up of primary particles which could combine together to form 'corpuscles'. After the set-back in progress caused by the invention of the phlogiston theory (concept of a 'volatile principle' contained in bodies freed by combustion) by Stahl in 1697, chemistry took on a scientific direction with the work of Lavoisier in 1770. Lavoisier showed the determining role of oxygen in combustion and oxidation, and exploding the notion of phlogiston and inaugurating a quantitative chemistry. The nineteenth century became "the century of chemistry" with the establishment of the basic principles of chemistry and their practical application (Lonchamp, 1993).

Pre-Hospitaller Period

The investigations in chemistry in Malta followed similar trends as on the continent. No information is available as to the philosophical attitudes towards the earth sciences during the Classical period in Malta. However, a tomb slab from a catacomb at Rabat (Malta) dated to the Palaeo-Christian period suggests that the medical physicians practising on the Island during that period were familiar with the humoural theory of disease described by Galen. The tomb slab depicts a series of medical instruments including bleeding cups used to correct the humoural imbalances believed to be caused by disease (Cassar, 1974; Savona-Ventura, 1999). It is likely that these physicians also subscribed to the theory that matter was made up of the four elements. The Medieval Period period in Malta was dominated initially by Muslim rule and later (after 1127) by Latin influences. It is likely that the scientific community of the late Medieval period, including physicians and pharmacists, subscribed to Aristotelian-Galenic humoural views.

Hospitaller Period

By the late Medieval period, Maltese physicians were apparently well versed in and subscribed to the Galenic views on disease, besides the views of other ancient and medieval authors including Rhazes (860-932), Avicenna (980-1037), and Avenzoar (1072-1162). Evidenced for this comes from a medico-legal report dated 1542 presented by two Maltese doctors to the Ecclesiastical Court (Cassar, 1974a). The practise of chemistry in Malta became closely related to pharmacology. Pharmaceutical lists of the mid-sixteenth century from Malta confirm that while the overwhelming preponderance of pharmaceutical substances was of organic sources, a few mineral substances were regularly used (Table 1). Worthy of note is the use of nitric acid,

MINERAL MATERIA MEDICA	1546	1590	18th cent.
Alumen (Coctum (?)): a mineral salt obtained by burning (*alumen ustum*) a type of rock; used for cicatrization of wounds.	❖		
Aqua fortis: Nitric acid or saltpetre acid prepared from potassium nitrate (*saltpetre*); a resolvent.	❖		
Diaiteon (Ceratum): composed of alum, calcium and verdigris; use unknown.	❖		
Diaquilon (Diachylon) Nigrum, Emplastrum: Made from the mucilaginous roots of *Althaea officinalis*, litharge (lead monoxide) and oils; an emollient and resolvent of tumours.	❖	❖	❖
Filonia persica (Philonium persicum): made up of white pepper, hyosciamus, sealed earth of Lemnos, dried preputial follicles from beaver, 'prepared pearls' and zedoaria; lozenge to arrest spitting of blood, vomiting and treat piles.		❖	
Terra sigelata (Terra sigillata): Sealed earth from a cave in Island of Lemnos (*terra lemnia*), occasionally mixed with other substances (*Confectio hyacinti* and *Theriaca*); as lozenge for bleeding and diarrhoea.		❖	❖
Coralli (Corallum): made up of ground calcareous corals mixed sometimes with opium, myrrh, cascarilla, and cinnamon; syrup to fortify liver and stomach.		❖	❖
Bolo armenu (Bolo di Armenia): clay high in iron content from Armenia; used orally as an astringent in dysentery and in bleeding.		❖	
Tucia: made up of zinc oxide, lead, and white wax; ointment applied to ulcers		❖	
Lapid. D. Pauli and *Linguae D. pauli pulv.:* made up of the powdered Limestone obtained from St. Paul's Cave at Rabat (Malta) and from powered fossil shark's teeth; antidote against poisons		❖	❖
Silver nitrate: as caustic against granulation tissue			❖

Table 1. Mineral Materia Medica

copper oxide, zinc oxide, alum, and salts of calcium, iron and lead. Many of the substances were probably imported from Sicily, since none were to be obtained from local sources (Cassar, 1976; Fiorini, 1988/89). The use of minerals in the local pharmacopoeia, including lead, mercury, silver nitrate, alum and calcium, continued well into the eighteenth century (Cassar, 1969; Cassar, 1964).

The formal study of Pharmacy in Malta was probably introduced with the establishment of the School of Anatomy and Surgery in 1676. The director of that School, Dr. Giuseppe Zammit, was also the teacher of botany and in 1690 set up at his own expense a botanical garden in the vicinity of the Sacra Infermeria with the aim of providing living plant specimens for the practical teaching of pharmaceutical botany. Dr. Zammit similarly introduced the teaching of chemistry in the school and gave practical demonstrations in the subject. Among the various chemical and pharmaceutical compounds prepared by Dr. Zammit was sodium sulphate. Until 1886 it was known in Malta as Zammit's salt (Cassar, 1964).

The Hospitaller Order of the Knights of St. John was made up of the elite of European nobility, and it is not surprising to find that many of its members showed an active interest in the various aspects of science. There is evidence to show that GrandMaster Pinto de Fonseca practised alchemy. Fra Pinto, a native of Portugal and Bailiff of Acre, was elected GrandMaster to the Order on the 18th January 1741. His reign is usually described by historians as long, prosperous and glorious. It was certainly long-lasting 32 years, but its prosperity and glory appear to have been over-rated. Pinto died on the 23rd January 1773 at the veritable age of ninety-two. While his old age may reflect the successful discovery of a secret *elixir vitae*, the financial situation that Pinto left behind him definitely confirm that he was unable to discover the secret of transmutation of metal.

While the statutes of the Order of St. John strictly forbid the practice of alchemy, Pinto is known to have been very interested in alchemy and experimented in his personal laboratory in the Valletta Palace. The Order' statutes clearly defined that *"The same punishment (rowing on the galleys for five years) will be meted out to those goldsmiths and silversmiths who dare receive or work any kind of metal for alchemy, without earning any exemption of the penalty on the plea of ignorance"*. Pinto's interest in alchemy appeared to be limited to the old school searching for the philosopher's stone of eternal life and for turning base metal into silver or gold. European alchemists are known to have been well received in Malta, and freely used Pinto's laboratory. A manuscript diary belonging to Ignatius Saverio Mifsud dated 1754 states that "For some months there has been lodging in the Palace of His Most Serene Highness a

man who claims to be a chemist. This man was received by the afore-mentioned Highness and admitted to his full confidence, being lodged in his Palace and maintained at his own expense, occupying rooms surrounding the loggia of the fountain made by His Highness in the Garden Court. And the reason of all this is that he has announced his intention to concoct a certain elixir of life designed to keep man sound in health and strength and mind" (Freller, 1997). During the period 1762-66, the alchemist Giuseppe Balsamo, known as Count of Cagliostro, may have also been lodged in Pinto's Palace. The notorious Balsamo, accompanied by his alchemist friend Althotas, were driven into Malta by stress of weather during their return to Europe after visiting Turkey. In Malta, they worked in Pinto's laboratory for some months and tried hard to change a pewter platter into a silver one. Balsamo, having less faith than his companions, was soon wearied and obtaining from his host many letters of introduction to Rome and Naples, left Pinto and Althotas to find the philosopher's stone and transmute the pewter platter without him. Althotas, who according to Balsamo was a member of the Order of the Knights of St. John, may have died in Malta (Mackay, 1841).

Experimentation in Malta was not only restricted to alchemy. Several members of the Order published theses that dealt with various aspects of science - particularly medical and natural sciences. Dr. Josephus Demarco (1718-1793) prepared a manuscript entitled "*De philosophiae Experimentalis Natura, constitutione, objecto etc. aliisque rebus quae philosophiae tyronibus cognitu maxime sunt necessariae*", which discussed experimental philosophy and its importance in the teaching of apprentices. In addition, his inquiring mind is reflected in other non-medical thesis dealing with logic, elementary arithmetic, plane trigonometry, experimental physics and hydrostatics (Vella, 1999).

The ousting of the Order of St. John from Malta in 1798 resulted in a short interlude whereby the Maltese Islands came under French dominion. On the 18th June 1798, the University was abolished and a central school established. This school envisaged the appointment of eight teachers or Professors including Professors of Chemistry and of Mechanics and Physics (Hardman, 1909). The civil strife that ensued in the two years at the end of the eighteenth century stopped all plans towards developing an education programme on the Islands.

Nineteenth and early twentieth century

The close links between the study of chemistry and pharmacology continued well into the subsequent period. Mineral substances continued to be used in the nineteenth and early twentieth century. The list included, among others, magnesium sulphate, bismuth subnitrate, bicarbonate of soda, hydrocyanic acid, ammonium carbonate, citrate of iron, calcium salts, lead plaster, potassium iodide and bromide (Cassar, 1969). The teaching of chemistry continued to be linked to medical education. The re-organisation of the university in 1800 after having been disbanded during the French interlude required the setting up of chairs in medicine, anatomy and surgery, pathology, and physiology. Forensic medicine, hygiene and pharmacology were introduced as separate subjects during 1829-34. In 1836, a Royal Commission was appointed to investigate the general administration of the Islands, including the university. The Commissioners proposed five professorships - anatomy and surgery, medicine, obstetrics, chemistry, and botany - to bring the Malta University in line with other Medical Schools in England. These proposals were embodied in the 1838 Statute of the University. The first Professor of Chemistry to teach at the Malta University was Prof. G.G. Aquilina (1834-1859) who set up a regular chemical laboratory at the University. By 1856 Organic Chemistry was being taught for 41/2 hours each week. In the revised 1887 University Statute, the number of professorships was augmented to six, which included a Professor of Organic Chemistry, Practical Chemistry and Materia Medica. In 1900, a Professorship in Pathological Anatomy was further set up which ensured the training of medical students in the chemical, bacteriological and microscopical examination of pathological specimens (Cassar, 1964: p.448-461).

The teaching of Chemistry to medical students became more and more important with the increasing use of laboratory investigations in diagnosis and postmortem studies. A post-operative exudate was submitted by the surgeon Dr. P. Fabrizi who commented that "*siffatta sostanza essendo stata analizzata dal rispettabile mio amico Dr. Aquilina, Professore di Chimica in questa Universita`, fu da lui riconosciuta per un carbonato di rame*" (Fabrizi, 1841). Prof. G.G. Aquilina also performed chemical analysis on excretions, on urinary calculi, and cerebrospinal fluid (Cassar, 1964: p.540). Another contemporary proponent of laboratory investigations was Prof. C. Schinas (Professor of Medicine). In his medical journal *L'Ape Melitense* (published Sept-Dec 1838), Schinas encouraged the use of laboratory investigations, but warned against considering these as an easy solution to therapeutic problems (Schinas, 1838). The problems of laboratory diagnosis in the detection of blood in stains - using microscopy and chemical tests - were discussed by three contemporary doctors including Prof. G.G. Aquilina, Dr. F.L. Cravagna and Dr. T. Chetcuti in 1841 (Filologo Maltese, 1841)

The increasing interest shown by local practitioners towards laboratory diagnosis was probably in part stimulated by contacts with British doctors and researchers who visited and worked in Malta. One important visitor was Dr. John Davy, brother of Sir Humphrey Davy who invented the safety lamp for miners and recorded the effects of nitrous oxide. John Davy, a military medical officer, was posted to Malta in 1828-35, and again visited the Island in 1838, 1839 and 1840. In the interim, he probably kept up correspondence with the local practitioners, since in September 1840 he was elected honorary member of the Societa Medica d'Incoraggiamento di Malta. Besides his military duties, Davy, during his posting to Malta, also had a busy private practice and acted as President of the Medical Committee that supervised civilian medical services. Davy was definitely acquainted with Prof. G.G. Aquilina and in 1840 had attended one of his lectures (Cassar, 1986).

Even before he came to Malta, Davy had already conducted several scientific investigations, including the preparation of phosgene gas (COCl2). While in Malta, he carried out several physiological investigations on the human body and the effects of various substances/ conditions on human tissue. He further carried out chemical studies publishing several papers including "Some Experiments and Observations on the Combination of Carbonic Acid and ammonia" (1833); "Some Observations on Phosphorus"; "Some Observations on a Note of M.A. Van Beek purporting to point out an error in the Bakerian Lecture of the late Sir Humphrey Davy on the Relations of Electrical and Chemical Changes" (1834); and "Some observations on Euchlorine relative to the question of its decomposition" (1834). His laboratory was sited in the Military Hospital. His instruments comprised a microscope, a galvanometer, Coulomb's electroscope, Harris's electrometer, a Leyden jar, a Voltaic cell and an electricity generating machine. Other laboratory items included glass retorts and tubing, a spirit lamp, an air pump with receiver, steam and mercurial baths, a fine balance, glass-stoppered bottles, wires of gold, steel, platinum and copper, and litmus paper. His list of chemicals included: alcohol, ammonia, manganese oxide, camphor, marble, hydrochloric acid, chlorate of potash, distilled vinegar, iron filings, hydrocyanic acid, mercury, nitrous oxide gas, oil of turpentine, silver nitrate, sulphuric acid, sulphuric ether, and aqueous solutions of chlorine, iodine and bromine (Cassar, 1986).

The use of laboratory investigations to augment the clinical diagnosis increased in the subsequent decades. Chemical and microscopical analysis of urine was repeated advocated in the local medical journal Il Barth edited by Dr. Giovanni Gulia (Gulia, 1871-72). The last decades of the nineteenth century (1875) saw the restructuring of the Sanitary Office, which was entrusted with the examination of articles of food and drink and with the investigation into the causes of infectious disease. This required the re-organisation of a Public Health Laboratory. The Professor of Chemistry at the University was ex officio appointed the analytical chemist of this laboratory. In 1895, the Public Health Department was revived. The first annual reports of the laboratory of the Public Health Department (1896-1899) prepared by the analytical chemist Prof. T. Zammit show that a large variety of investigations had been performed on a variety of foods and beverages. During these years, the Department was able to identify adulteration of coffee beans with lead chromate (Zammit, 1897-1900; Savona-Ventura & Sammut, 1998).

Contemporary period

The close links between medical studies and practice and chemistry persisted until the post-Second World War period. The University had established the Faculty of Literature and Science, which served as a preparation for the course of Medicine. During the triennial course for 1912-15 of the Faculty of Literature and Science, the total number of students pursuing studies in science amounted to 33 (Magro, 1914). The situation persisted in spite of the new 1915 University Statute. The Faculty of Science was responsible for academic courses leading to a degree of Bachelor of Science, a course of Pharmacy and preparatory courses for admission to the Faculties of Engineering and Architecture, and of Medicine and Surgery. The academic year 1930-31 had only 40 students enrolled with the Faculty of Science (Agius, 1932).

In 1957, a Commission was set up under the chairmanship of Sir. H. Hetherington to study the University System, its place and function in Maltese life, its relations with Government and the obligations of Government to the institution. The Commission reported that "*judged by the standards of most other Universities, science has hardly made more than a beginning. Both in equipment and in the depth of its scientific courses, the University seems to offer little more than is offered by an ordinary secondary school in the United Kingdom. ..... the main business of the Faculty of Science is to provide a certain amount of basic science preparatory to oither degrees. .... Hence the strengthening of the Faculty of Science appears to us to be one of the main and the first concerns of the University of Malta. .... In this faculty, the basic sciences of mathematics, physics, chemistry, biology and geology should be presented along fundamental (as opposed to applied) lines. ..... It is therefore clear that the development of a sound Faculty of Science is a prime necessity in the University. The new laboratories are there. These need equipment, some of which, we understand, can be made available. They need also some suitably trained technicians. But above all, they need well-qualified professors of physics, chemistry and biology*" (Hetherington et al, 1957). Both the Government and the University accepted the recommendations, and by the passing of the 1958 Royal University of Malta (Commission) Ordinance, the B.Sc. course came into its own (G.o.V., 1959).

The setting up of a formal B.Sc. course of studies by the University initiated a move towards the training of young graduates in various fields of science, aiming to serve education and technology. The first Professor of Chemistry in the newly set-up Faculty of Science was Prof. Philip Farrugia who occupied the post until 1960. A medical graduate, Farrugia was the first Maltese associate of the Royal Institute of Chemistry (1949) and the first fellow of the same institute (1957). He was succeeded by Professor W.G.H. Edwards in 1960.

Professor Edwards had a purely chemistry background. His appointment to the post of Professor of Chemistry in the Faculty of Science ensured that the traditional links between chemistry and medicine were truly severed. His experience in academic and industrial chemistry ensured that the chemistry module offered by the Faculty of Science could improve its standards to European levels with the inclusion of all the formal branches of chemistry, i.e. physical, organic and inorganic chemistry. The Faculty of Science received a further impetus with the transfer of the Department of Chemistry from Evans Buildings in Valletta to the new laboratories at the Tal-Qroqq Campus in 1968. The Department of Chemistry also promoted post-graduate studies with research activities in various fields, including the Orobanche Research Project funded by the U.K. Overseas Development Fund. A number of the early chemistry graduates from the Faculty of Science proceeded

Year	Honorary Graduate
1947	❖ Prof. R.V. Galea
1954	❖ Prof. E. Lapira
1960	❖ E. Medi
1965	❖ Sir R. Bradlaw
1984	❖ Prof. H.M. Gilles
1987	❖ Dr. J.H. Mercieca
	❖ Dr. A. Pardo
	❖ Prof. A. Prophet
1988	❖ H.E. Mr. J. Perez de Cuellar
1989	❖ Prof. F. Vella
1993	❖ Dr. G. Zammit Maempel
	❖ Prof. A. Zichichi
1996	❖ Mr. P. Pistorio

Table 2. Honorary Graduates awarded "Doctor of Science" by University of Malta

overseas to read for post-graduate doctorate degrees in chemistry. The return of these doctorate-qualified Maltese in the late 1960s and early 1970s saw the gradual transition from expatriate academic staff to Maltese academic staff. During Professor Edwards's tenure, Chemistry became more popular with students attending the Faculty of Science at the Royal University of Malta. The science student population in 1973 amounted 123, of whom 88 (75.6%) were studying chemistry as one of their main subjects (Anon., 1973). Prof. Edwards was succeeded by Prof. V. Ferrito in 1976. Prof. Ferrito joined the Faculty of Science in its early years in 1959 from where he graduated B.Sc. and M.Sc. He pursued his doctoral studies at the University of Swansea, Wales, graduating a Ph.D. in 1968 (Schiavone, 1997). Besides Prof. Ferito, a further eleven Maltese who read chemistry at the University of Malta have now attained a Ph.D., the majority from Universities in the United Kingdom with sponsorships by Rhodes, Commonwealth or University Scholarships.

Attempts were also made to promote an interest in Chemistry by the setting up of academic societies and the publication of journals. In 1948, Prof. Farrugia founded the Royal University of Malta Chemical Society with the scope of promoting an interest in chemistry, publishing its journal *The Chemist*. In May 1967, the RUM Chemical Society issued its second magazine *Orbital*, which continued publication for a year with the publication of three issues. The society persisted with its activities until 1969, the last activity in April 1969 being a Science Exhibition organised jointly with the Biological Society of the Royal University of Malta. After a period of hibernation, the various then-dormant science societies amalgamated in 1972 to form the Royal University of Malta Science Society. This included as members all the science students, academic and technical staff of the Faculty of Science as well as the University's Junior College (the latter students had organised their own science society - the Junior College Science Society in 1971 and published their own magazine The *Neutrino*. The Junior College Science Society survived until the educational reforms of 1974 whereby the Junior College administration shifted from the University to the Government Department of Education). The RUM Science Society issued another newsletter *Hybrid* in 1972. This ran for only a few years (Savona-Ventura, 1997; Ferrito, 1972).

Science education in Malta received another set-back with the education reforms engendered in 1980 when the Faculty of Science was abolished and amalgamated in the Faculty of Education as the Department of Mathematics and Science. The Faculty of Science was again re-established with the 1988 Education Act, which enabled the University to award Bachelor of Science and Master of Science degrees, and also Doctor of Science honoris causa degree, although the earliest award of a D.Sc. was awarded in 1947. The University science students set up the University Science Students Association (Univ., 1999). Interest in scientific matters continued to increase and a need was felt for a forum where graduates from various fields in science could freely discuss multi-disciplinary topics. The Malta Chamber of Scientists open to any graduate with a primary science degree, including medicine, dentistry and pharmacy, was inaugurated on the 28th July 1994 and issued its journal *Xjenza* in 1996 (Felice & Muscat, 1996).

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