

# Science at the Vatican

Ronald Rousseau

Centre for R&D Monitoring (ECOOM) and Dept. MSI, Catholic University  
of Leuven, Belgium, [ronald.rousseau@kuleuven.be](mailto:ronald.rousseau@kuleuven.be)

& Faculty of Social Sciences, University of Antwerp, Belgium,  
[ronald.rousseau@uantwerpen.be](mailto:ronald.rousseau@uantwerpen.be)

## Abstract

We first point out that the Holy See and the Vatican City State are two different entities. The Holy See has established or directs several universities, academies and other institutes of higher learning, be it that most of them are related to ecclesiastical and religious studies. Best known among these institutes is the Pontifical Academy of Sciences.

Next we performed a bibliometric study, by searching for "Vatican\*" as a country (CU=Vatican\*) or as a city (CI=Vatican\*) in the Web of Science (WoS). To the results of this query we added documents with (Vatican\* OR "Pontifical acad\*") in the address field and Rome as city. This search yielded 733 documents. This is the primary data source we investigated. The number of documents published yearly shows a clear increase, but citations are generally low. "Vatican" scientists (at least as covered by the WoS) are mostly interested in astronomy and related physics, followed – at a large distance – by religion as a research area and medicine.

It is well-known that WoS (and Scopus), as international databases, have a good representation in the natural sciences and medicine, yet they do not reflect the real situation in the humanities. As such the contributions of the Vatican in medicine, astronomy and related fields is probably correctly represented in this study. However, this statement does not hold for the humanities. Most pontifical academies have their own series of acta, scripta, studia selecta, etc., but these are not included in the WoS (or Scopus). Although the Vatican City State cannot be considered a major force in science, it does have its own niche and plays a preeminent role in the field of astronomy. Adding to this its unique position in religion and arts makes a bibliometric study of this small state quite fascinating.

**Keywords:** bibliometric study; Vatican City; astronomy; religion; address inflation

### **1. History: The relation between the Vatican City State and the Holy See**

Vatican City, officially the Vatican City State is an independent city-state enclaved within Rome, and established in 1929. With an area of 44 hectares and a population of about 1,000, it is the smallest state in the world by both area and population. The Vatican City is ruled by the pope who is, religiously speaking, the bishop of Rome and head of the Catholic Church. Within Vatican City are religious and cultural sites such as St. Peter's Basilica, the Sistine Chapel and the Vatican Museums.

The Holy See (in Latin: Sancta Sedes) dates back to early Christianity. The Holy See is the apostolic episcopal see of the bishop of Rome, the Pope, the universal ecclesiastical jurisdiction of the worldwide Catholic Church, and a sovereign entity. In international law, it is described as a non-state sovereign entity. As such the Holy See is headquartered in, operates from, and exercises "exclusive dominion" over the independent Vatican City State. The Holy See, not the Vatican City, maintains bilateral diplomatic relations with most states (excluding the People's Republic of China, but including Taiwan), signs concordats and treaties, and performs multilateral diplomacy with multiple intergovernmental organizations, including the United Nations. The Holy See can be seen as the diplomatic interface between the Roman Catholic Church and the rest of the world. Although the Holy See is closely associated with the Vatican City, the independent territory over which the Holy See is sovereign, the two entities are separate. They even have different official languages: Latin for the Holy See and Italian for the Vatican.

The independent Vatican City State came only into existence on 11 February 1929 by the Lateran Treaty between the Holy See and Italy. Before the Lateran Treaty, the Holy See had secular, namely over the Papal States, (752-1870) as well as spiritual leadership, namely over the Roman Catholic Church. The unification of Italy and the conquest of the Papal States made the pope a prisoner within the Vatican between 1846 and 1929 (giving rise to the so-called Roman Question), until Pope Pius IX signed the Lateran Treaty and gave up secular leadership over the Papal States, focusing on spiritual matters (Young & Shea, 2007). Yet, being the head of the

(secular) Vatican City guaranteed the independence of the pope from foreign powers or other secular interference. Vatican City exists as an absolute ecclesiastical monarchy and hence, is not a democracy, though its head, the pope, is an elected head. One may say that it is a very strange state, not based on any national community, and with a purely symbolic territorial base. For colleagues interested in the international legal status of the Vatican/Holy See complex we refer to (Graham, 1951; Young & Shea, 2007; Morss, 2016). For its relations with the United Nations we refer to (Chong & Troy, 2011).

## **2. Scientific Institutes**

Historically the relation between the sciences and the Roman Catholic Church has often been stressed: the Galilei case being the best known. Also nowadays, what reproductive medicine can and wants to do and the official point of view of the Roman Catholic Church on this matter, do not correspond.

The Holy See has established or directs several universities, academies and other institutes of higher learning, be it that most of them are related to ecclesiastical and religious studies. Yet, in recent centuries the Vatican has also actively contributed to the natural sciences. The most important ones among these institutes of higher learning are mentioned here. Yet, although they are situated in Rome, most of them are not within the Vatican borders, properly speaking.

### *2.1 Pontifical academies*

A pontifical academy is an academic, largely honorary, society established by or under the direction of the Holy See. These are: the Pontifical Academy of Fine Arts and Letters of the Virtuosi al Pantheon, the Pontifical Academy of Sciences, the Pontifical Academy of Theology, the Pontifical Roman Academy of Archaeology, the Pontifical Academy of Martyrs, the Pontifical Academy of St. Thomas Aquinas, the Pontifical Academy of Immaculate Conception and of Mary, the Pontifical Academy for Life, the Pontifical Academy of Social Sciences, the Pontifical Ecclesiastical Academy and the Pontifical Academy for Latin.

## *2.2 Pontifical Universities in Rome (none situated within the proper borders of the Vatican)*

These universities are higher education ecclesiastical schools established or approved directly by the Holy See, composed of three main ecclesiastical faculties (Theology, Philosophy and Canon Law) and at least one other faculty.

Rome has seven pontifical universities: University of St. Anthony (Antonianum), Gregorian University (Gregoriana), Lateran University (Lateranum), Salesian University (Salesianum), University of the Holy Cross (Santa Croce), University of St. Thomas Aquinas (Angelicum) and the Urban University (Urbaniana).

Probably best known among these institutes is the Pontificia Academia Scientiarum (Pontifical Academy of Sciences). Although formally established in 1936, its origins go back to 1603 (Accademia dei Lincei). Its headquarter is situated within the borders of Vatican City. Its goal is the promotion of the progress of the mathematical, physical, and natural sciences, and the study of related epistemological questions and issues. As the Academy and its membership is not influenced by factors of a national, political, or religious character it represents a valuable source of objective scientific information which is made available to the Holy See and to the international scientific community. Nowadays the work of the Academy covers six main areas: fundamental science; the science and technology of global questions and issues; science in favour of the problems of the Third World; the ethics and politics of science; bioethics; and epistemology. More than 45 Nobel Prize winners have been a member. Also the "father of the Big Bang", my fellow countryman Monseigneur Georges Lemaître was a member and was even its president for a period of time.

### **3. Arts, Humanities, Social Sciences and the Vatican**

Considering the study of religion and religious institutions as a part of the humanities, it is clear that the Vatican is a huge contributor of basic documents. In recent centuries some of these documents have had far-reaching social implications (Rerum Novarum; Humanae Vitae; Laudato Si). Moreover, cultural sites such as St. Peter's Basilica, the Sistine Chapel and the Vatican Museums play a leading role in the history of art. They belong to the World's Cultural Heritage.

## 4. A bibliometric study

### 4.1 Method

In March 2019, we searched for "Vatican\*" as a country (CU=Vatican\*) or as a city (CI=Vatican\*) in the Web of Science (WoS). The star is needed as, for instance, we found an article with city "CITTA VATICANO". To the results of this query we added documents with (Vatican\* OR "Pontifical acad\*") in the address field and Rome as city. This yielded 748 documents; removing those published in 2019 yielded a total of 733 documents. This is the primary data source (referred to further on as the Vatican Documents) we investigated. As a secondary data set we also collected the articles from the Vatican Observatory in Arizona (USA). This set contained 263 documents, with an overlap of 63 with the Vatican documents (hence 200 new documents). Although the large majority of these American documents are related to astronomy, some deal with religion, social issues and the history of the philosophy of science.

### 4.2 Findings

From now on we focus on the Vatican Documents, starting with the basic fact that they include 507 (normal) articles, 65 proceedings papers and 45 documents considered editorial material. There are further 41 meeting abstracts (typically for medicine), 37 book reviews, 24 review papers, 17 letters and a few other items. The publication data are distributed as shown in Fig. 1. The oldest document we retrieved dates from 1968 and is an address by Pope Paul VI to representatives of a food standards commission. The h-index (Hirsch, 2005) of the set is (only) 54; its year-based publication h-index is 15, which means that there are 15 years in this set with at least 15 publications (Mahbuba & Rousseau, 2013; Rousseau et al., 2018). The large majority of these documents is written in English (659), followed by Italian (21 documents); none is written in Latin.

As to the research areas covered (see Table 1), it is clear that Vatican scientists (at least as covered by the WoS) are mostly interested in astronomy and related physics, followed – at a large distance – by religion as a research area. We also mention philosophy, history and different aspects of arts (this is why we show the top 11 fields and not the top ten). We note that there are 12 records in the field of

Information Science and Library Science. Yet, these 12 records were cited at most once. The interest in astronomy is also shown in the list (Table 2) of most used journals.

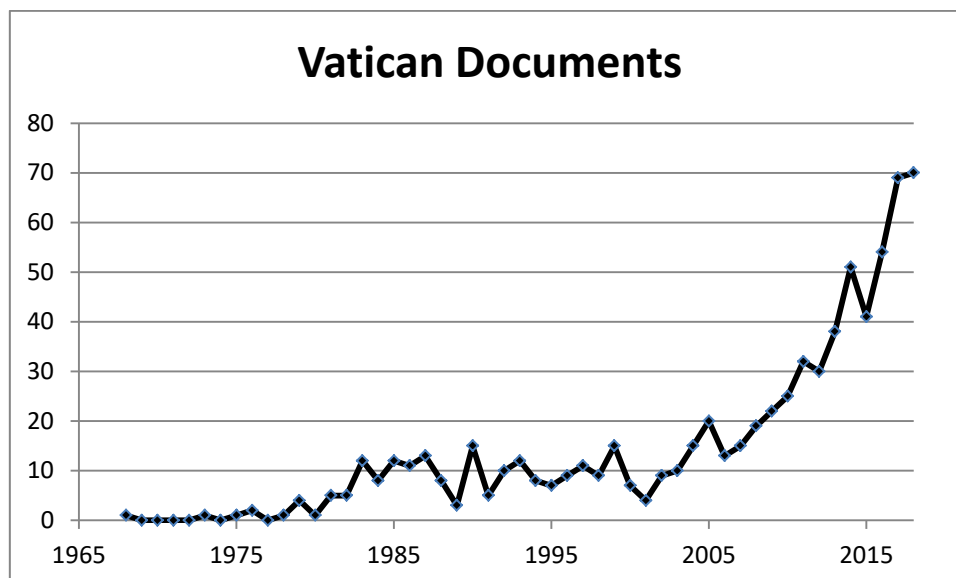


Fig. 1. Yearly number of publications in the set of Vatican Documents (WoS)

Table 1. Top eleven research areas (WoS) covered by the Vatican Documents

Area	Number of documents
ASTRONOMY ASTROPHYSICS	319
PHYSICS	72
RELIGION	68
GEOCHEMISTRY GEOPHYSICS	45
IMMUNOLOGY	35
ALLERGY	34
PHILOSOPHY	32
HISTORY	25
ARTS HUMANITIES OTHER TOPICS	20
SCIENCE TECHNOLOGY OTHER TOPICS	20
ART	16

Table 2. Most used journals and conference series by scientists contributing to the Vatican Documents

Journal	Number of documents
ASTRONOMY ASTROPHYSICS	96
METEORITICS PLANETARY SCIENCE	40
ASTROPHYSICAL JOURNAL	36
MONTHLY NOTICES OF THE ROYAL ASTRONOMICAL SOCIETY	36
ASTRONOMICAL JOURNAL	24
ASTROPHYSICAL JOURNAL LETTERS	22
INTERNATIONAL JOURNAL OF THEORETICAL PHYSICS	13
CURRENT OPINION IN ALLERGY AND CLINICAL IMMUNOLOGY	11
GENERAL RELATIVITY AND GRAVITATION	11
ICARUS	11
ASTRONOMICAL SOCIETY OF THE PACIFIC CONFERENCE SERIES	10
Selected other	
NATURE	9
SCIENCE	2

Checking the institutes to which scientists contributing to the Vatican Documents belong we see (Table 3) that astronomical observatories are high on the list. The term "Specola Vaticana" refers to the astronomical observatory near Castel Gandolfo in Rome. Because of the light pollution in and near Rome, the Vatican Observatory established the Vatican Observatory Research Group, with offices at the Steward Observatory of the University of Arizona in Tucson. Headquarters though remained in Rome. Hence the terms "VATICAN OBSERV", SPECOLA VATICANA and VATICAN ASTRON OBSERV, essentially refer to the same scientific institute. Recall that to those publications with a "Vatican" address we should add the 200 other ones with only an address in Arizona. Vatican scientists, moreover, make use of the European Observatory in Chile. Finally, we mention the Bambino Gesu Hospital in Vatican City where scientists in medicine (allergy, immunology) perform their research.

Table 3. Top Vatican institutes and those of collaborating scientists

Institute	Number of documents
VATICAN OBSERV(ATORY)	311
PONTIFICIA UNIVERSIDAD CATOLICA DE CHILE	139
SPECOLA VATICANA	114
UNIVERSIDAD ANDRES BELLO	100
EUROPEAN SOUTHERN OBSERVATORY	74
UNIVERSITY OF PADUA	63
IRCCS BAMBINO GESU	52
ISTITUTO NAZIONALE ASTROFISICA ITALY	49
UNIVERSITY OF ARIZONA	46
Selected other institutes	
SAPIENZA UNIVERSITY ROME	36
VATICAN MUSEUM(S) (different forms)	25
VATICAN ASTRON OBSERV	21
BIBLIOTECA APOSTOL VATICANA (different forms)	21
PONT ACAD LIFE (different forms)	10
LATERAN UNIV (different forms)	8
ARCHIVO SEGRETO VAT	7
SCUOLA VATICANA BIBLIOTECON (different forms)	7
KU LEUVEN	4
PONT ACAD SC (different forms)	4
PONT ACAD SOC SC (different forms)	2

Scientists in these Vatican Documents belong to the following countries: Vatican (539), Italy (309), USA (218), Chile (180), England (102) and many others. Clearly many scientists write their address as Vatican City, Italy, explaining why not all documents have the Vatican City State as country. As a Belgian I note that 16 documents include a scientist with a Belgian address. The most prolific scientist in the set of these documents is Dante Minniti, with an address in Vatican City and at the Universidad Andrés Bello (Santiago, Chile). Until 2014 he was Professor at the Department of Astronomy and Astrophysics at the Pontificia Universidad Católica in Chile. He has published 165 articles (in the set of Vatican Documents) explaining on



his own the occurrence of the Chilean institutes in Table 3. He is also the lead author of the most-cited article (cited 378 times - March 2019) in this collection:

VISTA Variables in the Via Lactea (VVV): The public ESO near-IR variability survey of the Milky Way

NEW ASTRONOMY, 15(5), (July, 2010), 433-443

DOI: 10.1016/j.newast.2009.12.002

This article has 67 co-authors.

Among the Vatican Documents we found a single-author paper with 11 reprint addresses (Zichichi, 2017). This case provides an example of "address inflation".

Finally, we mention a special item (classified as editorial material) co-authored by Pope Francis and Patriarch Kiril (2016). This document has not been cited yet.

## 5. Discussion and Conclusion

It is well-known that WoS (and Scopus), as international databases, have a good representation of the natural sciences and medicine, yet they do not reflect the real situation in the humanities. As such the contribution of the Vatican in medicine, astronomy and related fields is probably correctly represented in this study. However, this statement certainly does not hold for the humanities, with the situation of the social sciences somewhere in-between. Most pontifical academies have their own series of acta, scripta, studia selecta, documenta etc., but these are not included in the WoS. Scopus covers one book series, namely the "Atti della Pontificia Accademia Romana di Archeologia: Serie III, Rendiconti", cited only once during [2015-2017]. We also wonder why we could not retrieve a single item before 1968 and that 1983 is the first year in which the Vatican published more than ten documents (at least according to the WoS).

As the Vatican scientific institutes have a double purpose, namely providing a means for a dialogue between science (in its general sense, including the humanities) and the Church, on the one hand, and acting as sources of objective scientific information for the Pope and the Holy See, on the other, it seems to us that more could be done to reach this purpose. Nowadays, many countries develop current research information systems (Sivertsen, 2019) which include all peer-reviewed publications in

which a resident of one of the country's scientific institutes has contributed. This might be a way to make Vatican scientific results comprehensively visible. This might even be useful for the natural sciences, medicine and the social sciences as the coverage of the WoS is declining with respect to the total number of scientific publications (Larsen & von Ins, 2010).

Although the Vatican State cannot be considered a major force in science, it does have its own niche and plays a preeminent role in the field of astronomy. Adding to this its unique position in religion and arts makes a bibliometric study of this small state quite fascinating.

## References

- Chong, A., & Troy, J. (2011). A universal sacred mission and the universal secular organization: The Holy See and the United Nations. *Politics, Religion & Ideology*, 12(3), 335-354.
- Francis, Pope, & Kirill, Patriarch (2016). The divided mind of the black church: Theology, piety, and public witness. *Ecumenical Review*, 68(1), 139-146.
- Graham, R.A. (1951). *The Rise of the Double Diplomatic Corps in Rome*. Dordrecht: Springer Science + Business Media.
- Hirsch, J.E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences USA*, 102(46), 16569-16572.
- Larsen, P.O., & von Ins, M. (2010). The rate of growth in scientific publication and the decline in coverage provided by Science Citation Index. *Scientometrics*, 84(3), 575-603.
- Mahbuba, D., & Rousseau, R. (2013). Year-based h-type indicators. *Scientometrics*, 96(3), 785-797.
- Morss, J.R. (2016). The international legal status of the Vatican/Holy See complex. *The European Journal of International Law*, 26(4), 927-946.
- Rousseau, R., Egghe, L., & Guns, R. (2018). *Becoming metric-wise. A bibliometric guide for researchers*. Kidlington (UK): Chandos-Elsevier.
- Sivertsen, G. (2019). Developing Current Research Information Systems (CRIS) as data sources for studies of research. In: Glänzel, W., Moed, H., Schmoch, U. &

Thelwall, M. (eds.), *Springer Handbook of Science and Technology Indicators*. Heidelberg: Springer Verlag (to appear).

Young, S.E., & Shea, A. (2007). Separating state from church: A research guide to the law of the Vatican City State. *Law Library Journal*, 99(3), 589-610.

Zichichi, A. (2017). Abdus Salam, the electroweak forces, ICTP and beyond. *International Journal of Modern Physics A*, 32(8), Article Number: 1741004