

THE INTERNATIONAL ASTRONOMICAL UNION (IAU): A YOUNG CENTENARIAN (1919-2019)

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Abstract. The International Astronomical Union (IAU) has turned 100 this year. After a difficult and painful beginning in the aftermath of WWI, establishing itself as a leading international scientific union and solidifying at its first General Assembly in Rome (1922) with 207 individual members representing 19 countries, it has experienced a quasi-exponential growth since then, even accelerating during the “space race” era, to reach over 13,500 members today, representing 107 countries. This paper highlights some important steps in this evolution, the role of France within the IAU, and concludes with a brief outline of present and future projects.

Keywords: IAU: history, IAU: growth, IAU: Commissions, IAU: Divisions, IAU: Offices

1 Introduction: Before the IAU

On Nov.11, 1918, at 5:15 am, in a train parked on a discreet track in a forest near Compiègne, about 100 km north of Paris, an armistice was signed between the Allied forces and the new German government having been appointed just two days before, following the abdication of the German Emperor Wilhelm II. This event put an end to the tragic World War I, the first war in which science and technology played an important role in the conduct of the murderous battles that took place –although, after the initial army moves, the western front lines themselves, in Belgium and France, never changed in four years by more than a few tens of kilometers over a length of more than 500 km. An estimated one billion bombshells were fired, ten million casualties resulted directly from the war, followed by perhaps up to fifty million more resulting from the Spanish flu worldwide in the period 1918-1919. The world had changed irreversibly.

It was in the aftermath of this tragedy that the *International Astronomical Union*, the IAU, was born in Brussels, on July 28, 1919. [For detailed accounts of the history of the IAU, see the books by Blaauw 1994, Andersen et al. 2019, Sterken et al. 2019. This last book is referred to here as “S349”, mentioned after the name of authors of selected individual articles: e.g., “Montmerle, S349”.]

But the IAU was not created out of nothing. Long before WWI, astronomers had recognized the necessity of establishing international cooperation –one would say today “astronomy without borders”. At least, that was the hope (Trimble, S349).

It is commonly admitted that two major initiatives paved the way to the future IAU. Chronologically, the first one was the *Carte du Ciel* project, launched in 1887 by the then Director of the Paris Observatory and Academician Ernest Amédée Mouchez (1821-1892). This project (see Lamy 2008) consisted in eventually obtaining 22,000 photographic plates of 2° on a side, by gathering the collaboration and coordination of over 20 observatories worldwide, lasting an estimated fifteen years. Due to various, not-too-unexpected difficulties (political as well as technical), the project dragged on until 1970, but was still considered as a priority for astronomy in 1919, with a special “Standing Committee” taking over at the birth of the IAU (see also below).

The second initiative, also a scientific one, albeit more institutional, was the foundation in 1904 by George Ellery Hale, an American solar spectroscopist and then Professor at the University of Chicago, of the *International Union for Cooperation in Solar Research*. The start of WWI put an end to the Union activities, but, as an active internationalist (De Vorkin, S349; remarkably, he had been a PhD student in Berlin, 1893-1894), Hale was instrumental in the creation of the *International Research Council* (IRC) in 1916, i.e., a year before the US entered the war: one of the offsprings of the IRC was the IAU.

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Once the Americans were on board, and recognizing the role (positive and negative) that science and technology had played in the conflict, three “Inter-Allied Conferences” were organized, with the aim to discuss “The Future of International Organization in Science”. The first two, under the auspices of the Royal Society and the Académie des Sciences, took place before and just after the armistice was signed (London, Oct.9-12, 1918; Paris, Nov.26-29), in preparation for the “founding meeting” of the IRC, which subsequently took place in the Palais des Académies in Brussels (July 18-28, 1919), i.e., one month after the Versailles Treaty, which had put an official end to WWI (but, as we know, already contained the germs of WWII...).

2 The creation of the IAU (1919-1922)

The Third “Inter-Allied Conference” in Brussels, following the preparations of the previous conferences, was actually the first General Assembly of the IRC. It had two main objectives: (i) to approve its statutes, submitted by its Executive Committee previously appointed in Paris (with Emile Picard, mathematician and Permanent Secretary of the Académie des Sciences, as President, and George Hale as one of its Vice-Presidents), mentioning a possible revision after 12 years; (ii) to create and approve the statutes of its founding Unions, among them the IAU,* which was already so well structured (thanks to Hale) that it appeared very much as a model for the other Unions, including the IRC itself. The last day of the Conference (July 28, 1919), when the IRC statutes were finally approved, is thus taken as the birth date of the IAU.

For a number of participants, especially astronomers, the Brussels conference missed a key point: all the Unions created were termed “International”, but by construction, it was an “Inter-Allied Conference”, which meant that the Central Powers, which had lost the war (mainly Germany, perhaps the most prominent scientific country at the time, and Austria-Hungary) were excluded from it –and were explicitly excluded by the statutes from membership[†]. Also, the neutral countries were to be admitted on a case-by-case basis. France and Belgium, which saw the war destructions on their own soil, were particularly vocal against the admission of the Central Powers. For the IAU, these restrictions were progressively lifted (for instance via the possibility of inviting colleagues individually at scientific meetings), to be terminated in 1926, in part considering also the admission in the League of Nations (which had taken effect in 1920). But the real, official change did not happen until 1931, when the IRC changed its statutes to become ICSU –the *International Council of Scientific Unions*.[‡]

These major issues notwithstanding, at the end of the Brussels conference the IAU was in perfect standing. Not only were its statutes approved and its first Executive Committee established, with Benjamin Baillaud, Academician and then Director of the Paris Observatory (and also having been responsible for the first high-altitude telescope dome at the Pic-du-Midi Observatory in 1908), as President[§], but 32 scientific “Standing Committees” (the ancestors of the IAU Commissions; see Montmerle, S349) were created, covering all fields of astronomy at the time –even Relativity (“Standing Committee” No 1, chaired by Arthur Eddington, a strong supporter of Einstein, who had just returned from his famous successful solar eclipse expedition).

It is also worthy of note that two additional astronomy-related international organizations were also created in Brussels, independently of the IAU: the *Bureau International de l'Heure* (International Time Commission) and the *International Bureau for Astronomical Telegrams* (with their own organizational and political status; in parallel there were two scientific IAU Standing Committees on “Time” and on “Astronomical Telegrams”).

The main task of this Executive Committee was then to organize the first IAU General Assembly (GA), to be held in Rome three years later at the invitation of A. Abetti. At its foundation (1919, with ratification by governments in 1920), the IAU comprised 7 countries (Belgium, Canada, France, Greece, Japan –then a member of the Allied Powers–, UK and USA); Italy and Mexico joined in 1921. There were no individual “IAU members” yet, they would have to apply in time to be officially accepted at the Rome GA.

The GA convened in the prestigious Accademia dei Lincei in Rome, on May 2, 1922, to be adjourned on May 10. The three-year cycle of the IAU activities (the “triennium”) had begun for good: interval between GAs, renewal of the Executive Committee, financial report, assessment of the Commissions, admission of new

*The other Unions were: the International Union of Geodesy and Geophysics, the International Union for Radio Science, the International Union of Pure and Applied Chemistry, and the International Union of Biological Sciences.

[†]The Federal Republic of Germany eventually joined the IAU only in 1951, and the Democratic Republic of Germany was a member from 1962 until the reunification in 1990 (Wielen, S349). Austria joined in 1955.

[‡]now forming, with the *International Social Sciences Council*, the *International Science Council* (ISC) since 2018.

[§]See Bougeret, S349. The other members were: Alfred Fowler, UK, General Secretary, and as Vice-Presidents William W. Campbell (USA), Frank Dyson (UK), Georges Lecointe (Belgium), and Antonio Abetti (Italy).

individual members and national members (countries; with initially the restrictions mentioned above), etc. The next GA was scheduled to meet in Cambridge (UK) in 1925.

The Rome GA was attended by 83 participants (out of 207 individual members at the time); six women appear on the well-known group photograph (Blaauw 1994; also Montmerle 2019). Ten new countries (including neutral countries like the Netherlands) were admitted (the others were Australia, Brazil, Czechoslovakia, Denmark, Norway, Poland, Romania, South Africa and Spain), bringing the total to 17, already sampling, in spite of the international political situation, a wide distribution across the continents. Mussolini would be called to power by King Vittorio Emanuele II just a few months after the GA, but it was a very successful meeting and the IAU was already firmly on track.

3 Growth of the IAU

A century after its creation, the IAU now has over 13,500 individual members, representing 107 countries (visit the IAU website: <https://www.iau.org/>): a 65-fold increase in its astronomers (compared with a 3.8-fold increase in the world population, from 1.9 billion in 1919, to 7.3 billion in 2015), and a 15-fold increase in the number of (vastly different) member countries. How, and why, did this happen ?

There is no space here just to even summarize the various episodes that took place (including the difficult WWII and post-WWII years), but adopting a more global approach and considering major events in the history of astronomy during this period, it is possible to draw a number of interesting conclusions.

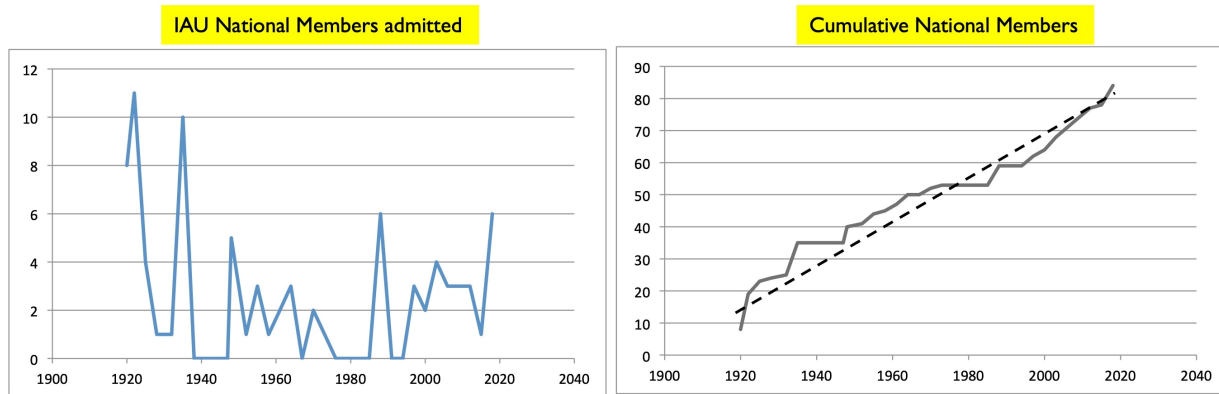


Fig. 1. Statistics of IAU “National Members” (i.e., adhering countries). *Left:* Number of countries admitted at each GA; *Right:* Cumulative number. See text for comments.

Let’s consider first Fig.1 (left): the histogram shows the number of “national members” (i.e., adhering countries)[¶] admitted at each GA (thus, every three years, except during WWII and on one occasion after WWII for political reasons). After the initial peak of 1922, one had to wait until 1935 (Paris GA) to see a second peak, with the arrival of China and of the Soviet Union (more precisely, of several Republics of the USSR). Then only a few national members (2-6, sometimes none) were admitted on average. Integrating this data, we obtain Fig.1 (right), which shows the corresponding cumulative distribution: this distribution is roughly linear, with ~ 10 times more national members in 2018 than in 1919: if the number of astronomers were simply proportional to the number of adhering countries, the IAU would comprise today no more than $\sim 2,000$ astronomers, i.e. ~ 6 times less than the actual number.

So let’s turn to the actual distribution of individual members (astronomers) as a function of time, GA after GA. This is shown on Fig.2, along with a (personal) selection of the most important events in the history of astronomy over the past century (for details, see Montmerle, S349). First, there is a “background” exponential growth, with an e-folding time of about 20 years, which means that, averaged over countries, the population of astronomers is growing faster than the overall population itself; at this scale, WWII itself didn’t have any influence (in fact, there were only about 500 astronomers worldwide at that time). However, the astronomers

[¶]not to be confused with “countries represented”, as these include non-adhering countries with too few members, in that case admitted on an individual basis. The IAU currently has 84 national members.

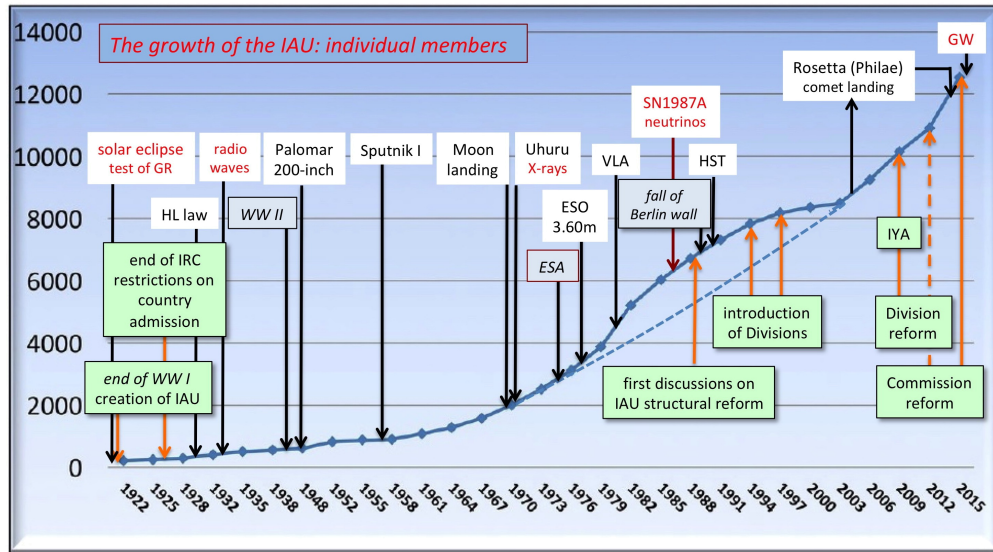


Fig. 2. Growth of the IAU over a century. See text for comments, and details in Montmerle, S349.

population started to pick up after WWII, with the important technological advances made during the war, like radars and, even more importantly, rockets and the resulting access to space (launch of the first Earth satellite, the Soviet satellite *Sputnik I* on Oct.4, 1957; IAU GA in Moscow, Aug.12-20, 1958).

Indeed, another feature is apparent in Fig.2: a “bump”, which is superimposed on the “background” exponential growth curve, starts to appear at the time of the Moon landings (*Apollo 11* to *Apollo 17*: July 16, 1969 –50 years ago– to Dec. 7, 1972). The first events later known as “ γ -ray bursts” were discovered by the *Vela* military satellites in the period 1963-1970, and the first astronomical satellite to explore the (non-solar) “X-ray universe” was *Uhuru*, launched on Dec.12, 1970. At the same time, important developments took place on the ground (creation of ESO in 1962, and of ESA, 1975; 4m-class telescopes, VLA, underground neutrino detectors, etc.), but it seems that, with the end of the Cold War (fall of the Berlin wall, 1989), and the resulting decline in the East-West competition, the “additional increase” in the number of astronomers started to decline as well, to merge with the exponential growth experienced previously. But the numbers were already very high, with $\sim 7,000$ astronomers at the time of the launch of *HST* (1990). Yet, thirty years later, this number has doubled !

While a more detailed interpretation of the growth of the IAU shown on Fig.2, especially in comparison with other scientific fields, remains to be done, the features described above are so clear that they demonstrate that astronomers worldwide (and the IAU itself) have been extremely successful in organizing themselves, both in their own countries (number growing faster than the population), and as a transnational community (for instance, via large European organizations or multinational collaborations) –and also, as discussed below, via their involvement in public activities at large.

4 France within the IAU

As we saw above, French astronomers have played a key role in the IAU since its inception. A century later, because of the IAU growth just described, in relative terms the influence of France has somewhat decreased. However, as shown in Table 1, it has one of the largest number of IAU members (in fact, the largest in Europe and the second largest in the world after the USA), ranking 6th in the number of astronomers per capita (out of 84 countries; after Switzerland, Denmark, Finland, the Netherlands, and Sweden).

Also, as shown on Table 2, its role at the Executive level (and also within Commissions and Divisions) remains strong. In particular, it is worthy of note that three major “firsts” in the IAU executive happened with French astronomers: first President (B. Baillaud, 1919), first Assistant General Secretary (J.-C. Pecker, 1961 –to become General Secretary at the following triennium), and first female President (C. Cesarsky, 2006). In addition, considering the Division Presidents and Commission chairs, over the last ten years (2009-2019) 144 French astronomers (nearly 20% of France’s total membership) have held executive positions for at least three years within the IAU.

Table 1. France’s IAU membership in relation with selected other countries¹ (census of 2018, Vienna GA)

Country	IAU Members (2018)	Population (Mcitizens)	Ratio (Number/100kc)
<i>Europe: EU</i>			
France	888	66	1.35
UK	747	65	1.09
Germany	728	81	0.90
Italy	707	61	1.16
Spain	397	47	0.85
Netherlands	272	17	1.61
<i>Europe: non-EU</i>			
Switzerland	146	8.4	1.74 ²
<i>Rest of the world</i>			
USA	3023 ³	316	0.96
Japan	767	127	0.60
China/Nanjing ⁴	737	1400	0.05

NOTES. (1) Ranked by number of individual members (membership). IAU data from its web site, population data from Wikipedia. (2) Highest ratio of astronomers per capita. (3) For the USA, the number of professional astronomers is actually significantly higher, but due to US policy those with non-renewable positions (post-docs...) cannot be IAU members. (4) For the IAU, China is considered a single country, but represented by two entities: “China/Nanjing” (mainland China), and “China/Taipeh” (Taiwan). For the historical context, see Liu (S349).

Table 2. French members of the IAU Executive Committee (1919-2018)

President	General Secretary	Vice-President
B. Baillaud (1919-1922) ¹	J.-C. Pecker (1964-1967) ²	H. Deslandres (1922-1928)
E. Esclaugon (1935-1938)	J. Bergeron (1991-1994)	C. Fabry (1928-1935; 1938-1944)
A. Danjon (1955-1958)	T. Montmerle (2012-2015)	A. Danjon (1944-1952)
C. Cesarsky (2006-2009) ³		A. Couder (1952-1958)
		C. Fehrenbach (1973-1979)
		C. Cesarsky (1997-2000)

NOTES. (1) First President of the IAU. (2) First Assistant General Secretary (1961-1964). (3) First female President.

5 Conclusions: The IAU today and tomorrow

The exponential growth of the IAU depicted in Fig.2 started to create problems in the late 80’s, when the 7,000 members mark was passed. Indeed, Commissions were the backbone of the activities of the IAU, but they had barely evolved, totalling ~ 40 at that time, compared with 32 in 1919, and most of them unchanged since then. However, the average number of members had exploded, from ~ 10 in 1919 to ~ 175 around 1990, some being even much more numerous,^{||} raising the question of the significance of Commissions. Reflections about restructuring the Commissions started, but the discussions, led by the Executive Committee, were difficult. Finally, a new structure level, the *Divisions*, was introduced by L. Wolter in 1994 while he was IAU President-elect, and officially approved at the Kyoto GA in 1997. (See the whole story in Montmerle, S349.)

The central idea was to gather the Commissions, without changing them, into a dozen large thematic groups (the Divisions), with the hope that they would evolve within them –by merging, changing, terminating, etc. Of course this didn’t change the arithmetic (some Divisions would have more than 1,000 members), but at least this reform brought some broad visibility to the activities of the IAU. In the end, however, not much happened to the Commissions. At the same time, the field of astronomy was evolving increasingly fast (think of exoplanets, discovered in 1995, now numbering over 4,000), independently of the IAU, some areas being even totally outside of the scope of its Commissions and Divisions (think of “multi-messenger astronomy”, now including gravitational waves).

^{||} At that time, registration to at least one Commission was mandatory for all IAU members

In parallel with science, the IAU had started to develop “societal” activities, i.e., activities involving a direct contact with the public at large, especially in developing countries. As early as 1964, an original Commission was created: “Commission 46, *Astronomy Education & Development*”. The goal of this Commission was to support dedicated astronomers –at first only a handful– willing to promote astronomy as widely as possible in the public worldwide, at all levels (see Hearnshaw, S349). It eventually grew to gave birth to several offsprings, like NASE, the *Network for Astronomy School Education* (2010), and, on a broader scale and in cooperation with South Africa, the OAD, *Office of Astronomy for Development* (endorsed by the 2009 GA in Rio de Janeiro). The interest of the IAU for education and outreach activities climaxed with the organization in 2009 of the *International Year of Astronomy*, under the auspices of the United Nations (UNESCO), which reached out to over 800 million people from 148 countries.

The IAU was then at the crossroads: (i) scientifically, new horizons were looming in astronomy and astrophysics, and (ii) more priority was given to education, outreach, and also astronomical heritage activities. The time was ripe for a fundamental reform of the IAU structures, which started in 2009 (see Montmerle 2015).

In essence, the three-tier structure in force since 1997 (i.e., Divisions, Commissions, and their Working Groups), was kept, but with a radical move: *the decision by the Executive Committee to terminate them all*, in two steps. First, introduce *ab initio* a new set of thematic Divisions (including one on Education and other activities, for better visibility), in cooperation with the Presidents of the existing Divisions, to be approved at the 2012 GA Beijing; second, set up a Call for Proposals to submit new Commissions to a joint Steering Committee composed of the Executive Committee and the Presidents of the new Divisions endorsed in Beijing, the selected Commissions being approved at the following GA (Honolulu, 2015). In the process, the number of Divisions was reduced to nine (from twelve), and that of Commissions to 35 (from 41). As a result, the activities of the IAU are now more in line with the most recent developments in astronomy (think of Commission D1 on *Gravitational Wave Astrophysics*, created before their actual discovery), as expressed by the community.

In parallel with this structural reform of Divisions, a second structure has been introduced: that of the *IAU Offices*, based not in Paris (the seat of the IAU Secretariat), but in other cities in the world. Following the example of the OAD (based in Cape Town, South Africa), two new “foreign” Offices have been created: the *Office for Astronomy Outreach* (OAO: based in Tokyo, founded in 2012), and the *Office for Young Astronomers* (OYA: based in Oslo, set up in 2015 to support and extend the activities of ISYA, the *International School of Astronomers*, itself founded by Commission 46 in 1967; Gerbaldi, S349). A fourth Office, the *Office for Astronomy Education* (OAE) is in the process of being created (ongoing selection of the site). The involvement of IAU astronomers in worldwide education and outreach has recently been praised (Entradas and Bauer 2019).

What about the future ? Based on these recent developments, an ambitious *Strategic Plan* (2020-2030) has been devised, which I encourage all astronomers to become familiar with (<https://www.iau.org/static/education/strategicplan-2020-2030.pdf>). Beyond the current $\sim 3,000+$ celebrations of the IAU centenary (see <https://www.iau-100.org/>), the IAU certainly appears as a very healthy, young international organization (van Dishoek, S349). *En route* for the next 100 years !

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