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Scientists and Their Society: Between Advocacy and Arbitration

ABSTRACT: Science is playing an increasing part in many decision making processes. It is now up to the scientists and scientific communities to advocate the importance of science in society. In doing so, we should be able to distinguish analysis from advocacy and should also be humble in remembering that good science does not necessarily produce an obvious policy main road. Our task is to ensure the maximal results, for the public at large and to offer advice to the society to gain a minimal risk. Along the line, we should be concerned of the value of good science education through formal and informal channels. One maxim that is sometimes overlooked is that we should not try to make politics more scientific. It is counter productive as it will turn science more political. More importantly, it is suggested that the following way and mechanism can be followed: (1) to improve the awareness of scientists about the current and future scientific and technical aspects of basic science; (2) to enhance scientific co-operations among developing institutions, including the exchange of scientific information; (3) to explore avenues of education, training and research on basic science subject for the benefit for people in the region; and (4) to create an "international" core group of scientists to pursue the objective of the cooperation and to link with advanced industrial countries. At the same time, our realization of the wealth of scholarly resources in the Asia-Pacific regions should grow. It is advisable, therefore, to start as a first step in the near future to pool these valuable human resources for environmental research.

KEY WORD: The scientists, roles, society, advocacy, science in society, good science education, and peace and wealth society.

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INTRODUCTION

> The image of Asia today is of untold millions of economically disinherited people, yet ancient humanistic civilizations of the region were once leading contributors to science and technology. What must be done to restore Asia to its former among peers, to bring the good life to its deprived millions (Indira Gandhi as cited in Hidayat, 2004:200).

The balance of scientific power is moving East as scientists in the Asia-Pacific region learn to collaborate more effectively. "Asian must be aware that there should be three players (in science): America, Europe and Asia in the sense that Asian science exists as a meaningful entity, absorbing contributions not just from Japan, China, Korea, and South East Asia, but also from India, Australia, and elsewhere is slowly gaining acceptance (*Nature* Editorial, 2008:3).

The two observations cited above on Asian panorama of science were made in different political and economical settings and 40 years apart. They intrigue my thoughts as I consider how scientists and scientific activities could help the nation build processes to impart their acquired knowledge. The second observation stated about sparked my enthusiasm by knowing that science in Asia is alive and hopefully in due time it can elevate the stature of the people.

Before I embark on the main theme, as stated by the title of this talk,[1] allow me to digress from the main avenue of thought by admitting the fact that I am deprived of the capacity, as well as the capability, to illuminate the marvel and tremendous progresses of your science. In the meantime, I have to gather my thoughts which resulted in the above mentioned title. It goes without saying that what is happening in our society at large guided my choice. I received enlightenments about optoelectronics and laser applications from the late Dr. Soemaryono, the founder of the school of electronics and laser applications at the University of Indonesia in late 1970s of the last century. He opened up my interest in this particular field of science as I believed it could help to propagate astronomy in Indonesia (Hidayat, 2000a).

But, as I have mentioned, I would hesitate to talk about the many wonderful discoveries and applications of Optoelectronics and Laser

[1]This paper was an invited opening speech to the International Conference on Optoelectronics and Application of Laser, in Yogyakarta, Indonesia, on August 2007; and it is adapted from the "Monthly Political and Economic Analysis" in *Postscript,* on January 2008.

Application, about which you all are going to elaborate the progress of this science during the next few days. My astonishment has stemmed from my interest of its application in my own scientific field, astronomy, but that is certainly only a miniscule part in the ocean of progress and sophistication of your science. Moreover, the time scale of new discoveries has become so infinitesimal that only experts can decipher its fully fledged meaning. Optimizing optional image subtraction, for example, has helped astronomers to carry out many astrophysical experiments that could not be achieved 20 years ago. Astrophysicists rely on the precise determination of light curves from sources which are either weak, weakly variable, and/or situated in a densely populated background. One prominent example in this field is the detection of extra solar planet using the transit technique (Marols *et al.*, 2006). Together with it are gravitational microlensing and supernovae searches. I am sorry but I think that it will be inappropriate for today's occasion if I continue discussing astrophysics and the implication of optoelectronics on astrophysics but I cannot deny my personal impulses to expound a view on some aspects of optoelectronics.

SCIENTISTS, LIFE SCIENCES, AND TEACHING-LEARNING PROCESS

In the past few years, I have been astonished by the far-field optical nanoscopy, which, in my perception, would have a strong impact on the progress of life sciences and in other areas benefiting from nanoscale visualization. It is gratifying to learn that experts can now take the advantage of the optical transparency of cells (Starch, Pantun & Mustach, 2002; and Wilardjo, 2009). Light microscopy uniquely provides noninvasive imaging of the interior of cells in 3D. This forced me to remember that the world of Ernst Abbe, which was the mainstay of the course on classical optics given at the school of Optoelectronics of the University of Indonesia, in the last part of the 1970s, seems to be so remote both in time and in space.

Despite this historical digression allow me to express my sincerest welcome to you all at this meeting and my gratitude to the organizing committee for having invited me to speak in front you distinguished scientists. I am also happy to report to the audience that some of those who were active in the roaring 1970s are now here amongst us. They, in their own right, hold prominent positions in the fields of optoelectronics and laser applications. More importantly, they are spreading their achievements in science to younger generations of Indonesians. This will ensure the continuation of this particularly important discipline of science.

At that time, the chapter on de-convolution was only touched on lightly, if not in passing, as the subject was still in an embryonic state compared to today's utilization of the topics. There is now a plethora of de-convolution methods which make all-pervasive presence of noise can be elegantly avoided and, at the same time, be exploited to the full extent to become information. We know now that de-convolution can be utilized as key areas in signal and image processing.

In the early days of the School of Optoelectronics (in Indonesia), laser application was discussed feverishly. Today, we have become more convinced that modern laser technology may well contributing to humanity by revealing the future of our past through preservation and revelation of our cultural heritage (Potakis, Wolfgang & Castillejo, 2006). Fascinating and providing much hope is that laser-based spectroscopic techniques inhibit a noninvasive character in that Raman spectroscopy are now capable of providing in situ and remote analytical information on organic substances. Their application in medical sciences will surely bring forward many pleasant surprises (Rhodes, 1999; and Wilardjo, 2008). I should refrain from citing the usefulness and front-line breaking aspects of your science as I have only a limited time and knowledge in this field. By that, I am convinced that much more will be contributed by your science for the betterment of our society and for the progress of science (Arryanto, 2007; and Barmawi, 2009).

Allow me now to employ the word "culture" in the meaning it bears for an educated audience is to enter at once into a scientific state of mind. For culture in that sense is an object for the inquisitive mind to study and report about an object (Hidayat, 2011a). Therefore, in order to ensure the successful transmission of culture, one should not forget that it is the heritage legacy of mankind which has been developed through the ages. Science should be regarded as culture. On many occasions, it is transplanted from one segment of the society to another; from one science center to other centers (Harrold & Eve eds., 1998; Hidayat, 1999; and Soekirno, 2008). In the present scientific era, many new discoveries have not only crossed geographic national borders, but also, more importantly, have brought about new excitement and, sometimes, wealth and comfort instantly.

The transmission of scientific knowledge would find good and long lasting impact when the teaching of science is bundled as a process, rather than exposing only numbers and data. Memorizing numbers and data is, of course, important but it will not present the process of acquiring knowledge and aspirations. Science is more than that. We are rational beings who should be aware of what is going on around us. Therefore, reasoning in order to bring home scientific thinking into our mind is important. Science is cultivated by mankind through reasoning and questioning. Therefore, the process of finding new things should be part of the general education, so that the mind of non-field scientists, and youngsters for that matter, become embedded in it and would be able to follow the trains of logic which are involved in finding new things (Hidayat, 2011b). This method of transmitting information is hoped to endow appreciation for scientific progress.

Many events in daily life are interesting, in the sense that many scientific phenomena and objects can be directly sensed or observed. Layman, including parliamentarians and the decision makers in the executive branches of the government, should be able to comprehend things on the bases of general principles of scientific knowledge and how it operates. Therefore, building up the sense of appreciation and comprehension for natural phenomena should be best taught through the basic sciences. Here, we see the relationship between various aspects of school-sciences and practice, which aim to make our youngsters, in particular in the Third World, scientifically oriented. They should be trained in scientific logic and observations which should lead to the use of analysis and deduction (Murdiyarso, Hidayat & Barmawi, 2004).

Science has known and recognized the *hypothetico-deductio* method in its long, successful history. In this context, success means not only the act of uncovering new things but, more importantly, also to show that science has contributed significantly to the process of elevating the position of man in nature. In almost all cases new inventions were, and are, achieved through experiments in order to obtain data and quantitative aspects of nature. We should provide our youngsters the ground for the education which would enable them to recognize the power of accurate data and measurements. Without these, science would find it difficult to find a fertile mind in our audience and should motivate them to carry out experiments and observations (Hidayat, 2004; Soekirno, 2008; and Wilardjo, 2008).

Education of any form, informal and formal, is a process to change from an inner, restricted, self to accommodate views from others. But accommodation of other views should not be the last step, because one has to select from the incoming information (Suriasumantri, 1986; and Suwirta, 2005). Here, the teaching of qualitative aspects of science should be introduced, so that the "student of science" knows the direction in the field. It is believed that the balance in the educational process should result in creating motivation to learn and to strive for new things. We need more public discussion of what science and technology means to our life.

In this, allow me to stress the importance for science that scientists take in these roles. Equally important is additional training at all levels to negotiate the potential of the clash of culture. A new class of scientists are expected to be cultivated namely those who have the capacity to advocate, without intruding on the harmony of other segments of the society, the usefulness of science in decision making as well as in writing the national agenda for development. The other class of scientists are able to provide sound advice to the decision makers in the society. He bears, by nature or nurture, a diplomatic trait whose main job is to offer arbitration of any dispute suggesting that the road map of scientific dialogue is important.

Physics, astronomy, biology, chemistry, geology, and many natural sciences offer ways of understanding the basic principles of knowledge: Nature is understandable and there are the so-called "Laws of Nature". I would like to quote Albert Einstein: "*The most incomprehensible thing about Nature is that it is comprehensible*". Science which has easy access to the facts can play a very important role in dispersing scientific attitudes and scientific disciplines. It is an honorable duty for us to disperse our knowledge, so that one should not misuse words and concepts of science, especially when applied to human affairs. Our duty is to erase the misconceptions caused by an arrogance that may arise in some segments of society so that people do not fall into the trap of pseudo-science or into personal feud (Hidayat, 1999; and Weinata, 2008).

A thorough appreciation of science, and of new findings, is essential to understand the nature of the material universe. And this should be taught in plain terms, in the light of the best modern knowledge. The purpose is to make man less the plaything of superstition. As for individuals, it is to show one that there are some predictable behaviors in the material universe, and thereby to reduce fear of natural phenomena. Another important aspect is to assist the development of the individual's personal philosophy and make him or her less prone to superstitions. Many examples can be cited from a day-to-day experience in a developing country (Suriasumantri, 1986; Weinata, 2008; and Wilardjo, 2008). Institutionally, scientists should be able to express the trend of intellectual power by means of exposing the statistics. This poses a danger as here actually can promote a misconception as layman are sometimes cannot distinguish the exposition of natural frequencies (of events) from probabilities. The more subtle thing is that if statistics exposed as natural frequencies, it can improve the statistical comprehension both experts and layman (Joesoef, 2000; and Sastrapratedja, 2010).

Informed laymen who have acquired scientific logic and principles may find it easier to accept new information about science as a cultural enrichment, to be integrated in his or her world view. The same is true for other professionals who read new findings say, of the genome of a certain disease and regard it as an extension of his logic and the accumulation of cultural wealth (McAllister, 1996). This will ultimately form a fabric of knowledge in the society with which he or she would see a better and varied universe.

We should be aware that on occasions, in some part of Asia, we witness the rise of a certain cult in the society. Our task cannot be directed to eradicate any sporadic anti-science movement but would be better aimed at improving science education for the population. The effort will hopefully produce and generate scientific literacy nationwide. Its success can be achieved only through concerted and coordinated efforts by many different institutions and individuals (Maddox, 1993). The players include professional scientists, educators, scientific professional societies, publishers, and curriculum developers. They should try to induce the scholarly concern for accuracy and the awareness of moral, social, and scientific problems of the society (Hidayat, 2011a).

We live in an ever changing world with a certain rhythm. But regularity cannot always be expected: if a sudden change took place unexpectedly it could generate incomprehensible and uncoordinated actions not only in mainstream society but also in government to such an extent as to cause imbalances in the society. Fresh in our memory is the change of the economic landscape which created the crises hitting the Eastern Asian countries since 1997. Some political actions, instead of long term economic rescue efforts, were taken to remedy the chaotic situation (Parry, 2008; and Crouch, 2010). Cosmetic short-term improvements were occasionally applied and successful but a complete social recovery is needed. In some countries, the resulting changes are relatively well studied but not generally felt nor appreciated in their totality or implications for society. Some countries were caught by surprise, not knowing what to do when the main staple of food became scarce and the cost of medicine soared beyond the reach of the majority of the population.

A deeper analysis is needed in order to find appropriate solution. A rule of thumb should be remembered that each country's policy reflects its historical and cultural circumstances and the changes being made in one country are not necessarily appropriate elsewhere (Huang & Tang, 2010). Has it something to do with our scientific endeavor? The answer is certainly yes and your presence is to help alleviate economic independency of the country. Our task is to rationalize the way science is run in order to stimulate intellectual creativity and to maximize its contribution to economic growth. The K-based economy is looming overhead and without scientific and technological contribution, the country's economy is doomed to fall behind the countries which can accommodate scientific and technological advances into their confines.

I am afraid that at this point I am not in a position to deal with the politico-economic matter more deeply; *firstly*, because it is not my field of specialty; and *secondly*, the time budget would not allow me to speak more extensively. My task would be easier if I choose to bring forth the positive aspect of the matter by encouraging the academic and scientific communities take their position in the new paradigm (*Nature* Editorial, 29/7/2010:531).

At the present time, the higher-learning institutions, with their scientific capacity and capability, are forced to take a much harder and more critical introspection of themselves. They should ask how to contribute to the development of the nation by finding a defense mechanism if a natural or man-made crises should happen again. It is time for us to pay our honorable "debt" which we have enjoyed during the normal and smooth period of the economic growth and expansion. One aspect, for example, that comes immediately into focus, is to revitalize basic training of all strata of educational process in which increased capability, empowerment, and motivation are of paramount importance (Parthasarathy, 2007).

In general, there is a prevailing notion that basic sciences which are needed to equip young people to master these aspects scientifically for them to embark on more complex demands in modern efficient, economical and technological activities. Professions for example in agriculture, medicine, and engineering sciences are required to have strong basic science background if they want to be more adaptive in any sudden forced changes. The educational sectors, in particular institutions of higher-learning, should not hesitate to review their mission and orientation to face the new paradigm (Supriadi, 1997; and Suyanto, 2006). And, sign a new social contract without leaving the basic premises for advancing sciences.

It is only natural that people look at university system which cultivates scientific entrepreneurship to shoulder the responsibility. As a matter of fact, we should accept it as an honorable duty to find solutions as how to develop a healthier society which could stand for leniently similar threat to make development sustainable. It will be the mark of the university's era in engaging sustainability issues. A society in which people's versatility results in self reliance and sufficiency (BNSP, 2010).

The changes in the economic landscape also produced a clearer notion of the existence of dual-use fields, namely those with science and commercial applications or basic science with practical applications. The scientific fields, such as pure chemistry and biology are sciences vital in the development of 21st century day-today affairs, such as biotechnology, food sciences as well as basic for microbiology. There is an array of examples that need to be treated immediately in many developing countries. Bacterial diseases are already known, but degenerative diseases are now taking place. To face this problem, or threat, conventional structures of curriculum may not be adequate.

Within the framework of the process of repositioning, the university should not forget to stress the importance of the magnitude of human impacts on the ecological systems of our planets (Soemarwoto, 1997; and Spencer, 2008). This would generate and stimulate the feeling among younger generations the intimate connections between the systems and health and economy of our nation. The crises also taught us to view the need of establishing systems, of social justice, national security and pride. Being self dependent is not a narrow chauvinism if we want to protect our abundant natural resources which have not been fully exploited. The related sciences which help to uncover them are certainly useful. These, expressed in simple terms, mean to redirect our commitment towards natural resources as our collective responsibility.

The main issue is, of course, priority and resources in both manpower and material. To grasp this, a sound science road map which enables the scientific community to perform their duty is of immediate concern (Meyers, 1992; Katili, 2007; and Katilti, 2010).

THE AGE OF SCIENCE AND THE UNIVERSITY MANDATES

There is no doubt that the future is the age of science, in which university mandates to cultivate science for people and science for the advancement of mankind, should remain the mission trademark. However, the system does not stand alone, it depends on the input and flow of students. Therefore, to meet the future the ethos for educating young people in the age of science must be cultivated. Some important aspects that should not be overlooked are: (1) A well-rounded curricula and its intellectual content; (2) Recognition that teaching is a task of primary importance in a modern society and that our society needs human talents and of a wide variety and that it is essential that every individual be given the maximum opportunity to develop his or her particular talents; and (3) An understanding that the advances of science and technology need specialty to the end and that all citizens of modern society acquire reasonable understanding of these subjects and that; and those with special talents in these fields have full opportunity to develop such talents.

It can easily be anticipated that many of the major scientific ventures in the 21st century may prove too costly for any one nation to handle. It would, therefore, be more than appropriate to spend some time pondering about a regional or, if necessary, international cooperation in order to ensure more meaningful scientific results. This makes the editorial in *Nature* (2008) cited above not only become more transparent, but serve as a guiding light. In particular, in some areas of research such as global warming, new emerging diseases, and food problems. Together, there is also the added value of existing national undertakings, which would be impossible to achieve without outside stimuli. While this connotation holds true in general, it must be hastily added at the onset, that one should not fall into the trap of the egalitarian principle, in which cooperation is interpreted as a mode of distributing scientific wealth, and neglecting a just-return (Hidayat, 1999). The true spirit of cooperation is to spread a division of labor. In itself reliance on science and technology of each participating element can be expected to be bundled into the driving force to propel science efforts.

There already exist centers and embryos of science centers in many Asian countries. It must be comprehended that while some are already deeply involved in a wide-range of research and explorations, others are still struggling to make their existence known or appreciated by their peers. Whatever their status now, the basic underlying principles for the establishment of centers is the same and was motivated by the same ideals. These were to pursue scientific studies about a particular domain be it a natural resources mapping or a national security measure or eradicating certain plant disease.

Take for example, the national biotechnology efforts which grow in a setting determined by the international need. Unfortunately, as it often the case, the international scenarios are set up by the have nations, whose programs and restrictions can inadvertently push new university or centers in developing nations backward. Unless there is the awareness about what we have the budget constraints may severely handicap the scientific progress in that particular area. In this case necessity breeds the need to establish a regional cooperation.

It is commonly perceived that the spin-offs and applicability of research projects form the critical factors in determining which project should become a priority. Priority may mean a national security, but it is not uncommon that the influencing factor is the growth of national economy and, perhaps, the balance of trade if the undertaking would involve many parties. Scientific cooperation is not free from this judgment. Indeed, there are scientific undertakings which require high technology and sophisticated instrumentation.

Equally important is the view on how to develop new capabilities for a well balanced utilization of resources and environmental management. By developing the indigenous scientific and technological capabilities, the efforts of exploiting space can hopefully create capable human resources (Federoff, 2009). In view of cost per nation, this kind of effort would certainly be advantageous.

Time has not only produced different shades of technological advances, but visions and inherent problems in other countries may have also played an important role. Extra efforts must now be exercised in order to make the fortunate and less fortunate nations share the common goals and concerns of many activities set is fighting disease or pests. Science and technology transfer in this area, but it is not an easy process as it looks on the surface. It involves transferring concepts and knowledge of a rather complex nature. As it has happened on many occasions, the process may end up in forcing others to carry out new things or new ways of thinking. The preparedness of any nation at the receiving end to change the mode, tempo and habit of a lifestyle, from whatever cultural background, to the new scientific and technological way of thinking is certainly a prerequisite for successful transfer and cooperation. It is not an easy task and is almost always accompanied by time lag.

Speaking of institutions, let us take a look at the common conceptualization of the relationship of institutional missions, goals, and objectives. The soul of an institution is the mission, which will distinguish it from an organization (Gaffar, 2010). The basis upon which missions can be appreciated by the participating nations may be a consensus to undertake and to solve common problems. The results of such an undertaking should, at least, produce immediate tangible and intangible impacts on the development of the participating nations. Preferably, it can be accepted by a wider circle of nations. Take for example, the problem of earthquake and volcanism and other earth phenomena which are dealt with daily in Indonesia. More than 70% of the world's volcanoes reside in the Asia-Pacific regions (Katili, 2010). Monitoring their activities, which would lead to a method of providing an early warning system of volcanic eruption would not only be of interest to the people in the area but also for the rest of the world. The impact of great volcanic eruptions have shown to disrupt the atmospheric calamity and induced climatic change.

Opportunities, demands, and constraints are part of the ingredient that would certainly make institutional building grow. To study in depth a particular phenomenon that is of interest to many nations in the region, maybe provided only by a certain, limited, geographic boundary on the surface of the earth. If the result of such a study is expected to offer far reaching consequences, then one should recognize the unique opportunity in such a way that the development of indigenous capability should not be postponed. The science leadership in this case has to shoulder a dual-role in which it is expected not only to uncover the truth of the phenomena but also to share his knowledge for the sake of development process with his partners. This mode is of particular importance if the study is a long-term project which requires a sustained commitment by all departments and agencies. To cite the case of botany, zoology and forestry Indonesia, as a country, should be ready to offer her services (Supriatna, 2011). Where else can one study the multitude living biota in a tropical forest?

Institutionalization, rather than organization, for scientific efforts would, therefore, be expected to achieve a better result where continued growth and self renewal can be foreseen. It should not make scientists become *paria* in their own country. Institution connotes several meanings in behavioral sciences, but the main characteristic is that the institution is a responsive, adaptive organism which is the natural product of scientific need and pressure (Hidayat, 2011b). Therefore, it is more advantageous for global efforts in science because there are many turns and choices, in particular the use of basic capabilities men and woman and concepts for the future. At the same time, it will become a melting pot of talents which hopefully would create a healthier atmosphere for university.

We cannot neglect the fact that there are interdependencies of political, economic, and scientific or technical factors which would actively shape the success for any future undertaking. One may naturally ask whether a successful endeavor in scientific cooperation would be automatically applicable in technology. It is acknowledged that some of the Asian countries have reached a certain level of sophistication in the fields of agro-sciences which are needed to feed more than 10^9 mouths in the regions. Some argued about the situation in the framework of dynamic change to chose strategic environmental and basic problems in order to improve the scientific map.

In order to achieve the goals, it is suggested that the following way and mechanism can be followed: (1) to improve the awareness of scientists about the current and future scientific and technical aspects of basic science; (2) to enhance scientific co-operations among developing institutions, including the exchange of scientific information; (3) to explore avenues of education, training, and research on basic science subject for the benefit for people in the region; and (4) to create an "international" core group of scientists to pursue the objective of the cooperation and to link with advanced industrial countries (Sambodo, 2004; and Abdul Rachman, 2009).

At the same time, our realization of the wealth of scholarly resources in the Asia-Pacific regions should grow. The question that arises now is how we are going to promote many of the comparative advantages to generate the competitive benefit. It is advisable, therefore, to start as a first step in the near future to pool these valuable human resources for environmental research (Hidayat, 2009; and Jacobson & Debucchi, 2009). I hope it is not a farfetched idea.

In the past decade, public concerns about the consequences of human activities on our earth are forcing considerable shift in priorities. The discoveries of CFC effects on polar ozone have strongly emphasized the need for understanding earth atmospheric circulation and chemistry. Studies related to this are certainly a fruitful ground for scientific cooperation. Many other examples can be presented to augment the case.

CONCLUSION AND REFLECTIONS

Before ending my speech, allow me to reiterate some of the points I have briefly sketched. It has become clear that science is playing an increasing part in many decision making processes. It is now up to the scientists and scientific communities to advocate the importance of science in society. In doing so, we should be able to distinguish analysis from advocacy and should also be humble in remembering that good science does not necessarily produce an obvious policy main road.

Our task is to ensure the maximal results, for the public at large and to offer advice to the society to gain a minimal risk. Along the line, we should be concerned of the value of good science education through formal and informal channels. One maxim that is sometimes overlooked is that we should not try to make politics more scientific. It is counter productive as it will turn science more political. More importantly, it is essential that scientists understand what science can offer in the domain of certainty and risk.

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