Alessandro Vitale

How did you spend your career?

After obtaining a master's degree in biology at the University of Milan (Italy) in 1977, with a specialization in plant biochemistry, I received a fellowship from the CNR Institute of Plant Biosynthesis, now the Institute of Agricultural Biology and Biotechnology (IBBA), to study the biochemistry and genetic diversity of maize storage proteins. During that time, I became increasingly interested in the protein secretory pathway, which in all eukaryotes takes care of the synthesis, structural maturations, and correct intracellular sorting of thousands of proteins. Consequently, I moved to the laboratory of Maarten Chrispeels at the University of California, San Diego, where I was a postdoctoral research associate in 1982–1983, studying plant protein glycosylation and its possible relationships with protein sorting to the vacuole. I was then hired as a staff researcher at IBBA, where I am now research leader. From 1998 to 2006, I was an adjunct professor on annual contract at the University of Milan for the master's degree in plant biotechnology, teaching plant cell biology and its biotechnological implications.

My research activity during these years has been devoted mainly to the study of protein synthesis and the biogenesis of intracellular compartments in plant cells, especially the endoplasmic reticulum (ER) and vacuoles. I have applied this knowledge to defining the mechanisms of accumulation of seed storage proteins, which are the major source of protein for human nutrition; improving strategies to increase their nutritional value; and exploiting plants to produce recombinant pharmaceutical proteins, such as immunoglobulins and potential vaccines. Protein folding and trafficking along the secretory pathway are regulated at multiple levels, from structural modification in the ER and the related mechanisms of quality control, to sorting, to the correct compartment of action and stability. We have worked on defining the signals for vacuolar sorting, on the interactions between molecular chaperones of the ER and newly synthesized polypeptides, and on the molecular features that regulate the assembly of cereal storage proteins into protein bodies, which are unique structures in the seeds of these plants.

During the past 20 years, I have become increasingly involved in science communication and popularization within communication groups of the Italian Society of Agricultural Genetics, the Italian Society of Plant Biology, and the Italian Federation of Life Sciences. In the era of wide Internet use and social network antiscience propaganda, I believe it is important to improve the scientific literacy of citizens for making decisions on several social issues and, especially for plant science, to support a rational view on the role of genetics in agriculture.

What do you consider to be your most important contributions to plant science?

At the end of the 1980s, we decided to investigate whether the then newly discovered quality control mechanism in the ER is also active in plants. Through interactions with protein folding helpers, quality control retains newly synthesized polypeptides in the ER until they are properly folded and, in the case of multi-subunit proteins, assembled into correct oligomers; if correct maturation cannot be achieved, the defective polypeptides are degraded.

I chose to study phaseolin, a homotrimeric vacuolar storage protein of the common bean. For the mRNA expression system, I initially used Xenopus oocytes, in which the level of expression of a given protein can be easily modulated by changing the concentration of an injected mRNA. We found that below a certain amount of mRNA, phaseolin is synthesized but does not reach a critical concentration in the ER that promotes assembly; therefore, it remains monomeric. We also found that monomeric

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phaseolin polypeptides remain in the ER and do not progress along the secretory pathway. A few years later, we used transgenic plants to produce a truncated form of phaseolin that is unable to assemble. The outcome confirmed and extended the results of oocyte expression, showing that the mutated form of phaseolin remains in the ER of plant cells instead of being delivered to vacuoles. It undergoes abnormal, prolonged associations with the ER molecular chaperone BiP. We also showed that newly synthesized wild-type monomers of phaseolin, not yet assembled, are associated with BiP in the ER of bean cotyledons.

Together, these experiments were the first demonstration that protein quality control occurs in the ER of plant cells, where it affects proteins destined for the vacuole, and that BiP plays a major role in this process. Today, protein quality control and the associated unfolded protein response mechanism are recognized as playing a major role in many aspects of plant life. At the beginning of this century, we showed the mechanism by which a model cereal storage protein forms protein bodies in the ER, instead of trafficking along the secretory pathway, operating through the formation of very large disulfide-linked insoluble polymers. This mechanism can be used to increase the accumulation of foreign proteins in plant cells.

When did you become a member of ASPP/ASPB?

I became a member of ASPP/ASPB in 1999. I attended ASPP meetings before then, and I personally knew a number of ASPP members, including Natasha Raikhel, Brian Larkins, Steve Howell, and of course Maarten Chrispeels, to name just a few. From the first one I attended, I found ASPP meetings very exciting for the outstanding science and the numerous educational and outreach activities. They were very different from meetings of Italian societies, which were almost exclusively devoted to scientific talks, and this was a turning point for me. It made me realize that scientists, in addition to doing the best possible research, should be ambassadors of scientific thinking for all citizens, and especially for educational and political institutions.

How did the Society impact your career, and what motivated you to become a Founding Member of the Legacy Society?

ASPP/ASPB had a fundamental impact on my career. Being part of the largest plant science community in the world opened my mind. I had the opportunity to converse directly and in some cases collaborate with outstanding colleagues with exciting visions for the future. I worked as a coeditor of *The Plant Cell* for five years, when Ralph Quatrano was editor-in-chief. That was a fantastic opportunity, not only for my scientific growth, but also for my appreciation of the devotion of the journal staff and ASPB people in general to rigorous but open-minded scientific thinking. I learned from ASPB and its journals how science should progress; that science should have no frontiers, in that ASPB journals are published in the United States but run by scientists working all over the world; and how scientific societies have a fundamental role in creating communities among scientists, promoting fruitful competition and collaboration at the same time. When I learned of the Legacy Society, it was natural for me to become a Founding Member. ASPB has done so much for me, and with this initiative I can give something in return; most importantly, this will be good for future generations of plant biologists.

What important advice would you give to individuals at the start of their career in plant science?

Being a scientist is a privilege that has its costs. It is difficult to provide significant contributions, and it is very easy to lose contact with the frontiers. Here are a few suggestions:

- Remember that scientific thinking is not natural: natural thinking is associative, not rational. This means that in planning experiments and interpreting their results, you must always fight irrational thinking.
- Make use of all possible opportunities to work in different laboratories and scientific environments. In this regard, do not do what I have done: my major mistake was to spend just one period of time outside CNR. If you can, go abroad, no matter where.
- Be a voracious reader of scientific papers, and go to meetings.
- Do not hesitate to ask questions and communicate your doubts.
- Practice giving public talks: by

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making oral presentations, you will immediately know whether what you have done makes any sense. Also, remember that if no one understands what you are talking about, you are wasting your time: the purpose of communication is to provide new information and discuss ideas, not just to show you have done a lot of work.

- Once you have your own lab, trust your younger collaborators, and make them feel important.
- Communicate to the general public the importance of the scientific method. If citizens are hostile to science, then decision makers will not support it. This is particularly important in plant science and agriculture, which are currently under attack by nonscientific thinking and fake news.

Academic Family Tree
https://academictree.org/plantbio/tree.php?pid=799675