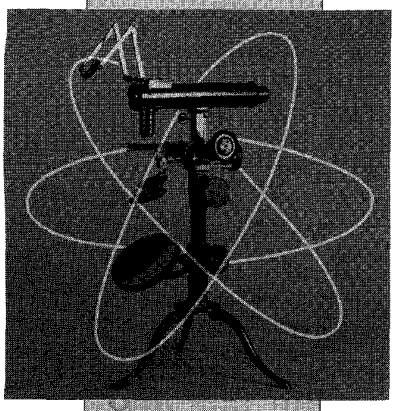


From the Guest Editor

I don't mind being bone and feathers, Mum. I just want to know what I can do in the air and what I can't, that's all. I just want to know. [...] It wasn't long before Jonathan Gull was off by himself again, far out at sea, hungry, happy, learning."

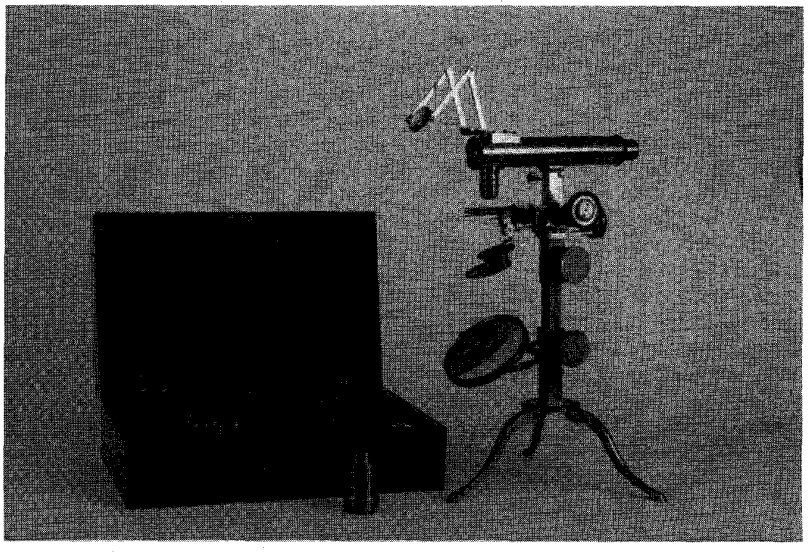
[from "Jonathan Livingston Seagull, a story," by Richard Bach, 1972]

Alberto Diaspro
University of Genoa

Sometimes you sit down in front of your computerised microscope and you think that everything has been done in microscopy. Then you move to your library: "Hi Lorenzo! Hi Angelo! (the librarians) How are you? I am just looking around!". AND you find a lot of new papers, of hints in microscopy... Now, I hope that this special issue can stimulate advances and research work in the area of microscopy. I also think that Electrical and Electronic Engineers, with experience and feeling in Medicine and Biology, can greatly contribute to progress in this field.

I have to confess that "happiness" is the main thread of the work done for this issue: the keyword. Something like an happy dance around a fire. Happiness for this opportunity, happiness for all the authors that accepted and for those who tried to do that, happiness for my new growing laboratory equipped with AFM, STM, optical and electron microscopes, happiness for all those special guys I am working with NOW, happiness for living with my wife Teresa and my daughter Claudia, happiness for all the e-mail messages there were sent/received to/from Al Wald, happiness for everything happened in this period to me.

More technically, the purpose of this special issue is to introduce, to the non specialist, some of the classical, novel, and improved microscopical techniques and their applications to medicine and biology. Moreover, my hope is to call the attention of the specialist to further needs and "cross-correlated" solutions in techni-



Amici's achromatic optical microscope, realized in Florence, Italy in 1830. The objective of this microscope can be considered a prototype of the modern planar achromatic objective. It can be found at the Department of Physics, University of Genoa, a donation of the Marquis Marcello Luigi Durazzo in 1835. The photograph is a generous gift of Professor Giovanni Boato, taken from his book on historial scientific instruments of the 1800s; G.Boato, G.Bruzzaniti, "Strumenti nella Fisica dell'Ottocento", Sagep editrice, Genova, 1993.

cal developments and to new problems approachable by means of modern microscopies. Precisely, one of the goals of biology and medicine is to understand the complex and delicate relationship between structure and function in living systems. The "Microscope" was (and is) a very fundamental tool for achieving this aim. Apart from other historical considerations, the word "microscope" was coined by Johannes Faber in 1625, for the very same instrument that Galileo Galilei called "occhialino".

From the historical gallery (see photo) is Amici's microscope, built in Florence on 1835. This perfectly functioning microscope is preserved at the Department of Physics of the University of Genoa, thanks to the precious work done by Professor Giovanni Boato. Giovanni Battista Amici combined the qualities of theorist, practical optician and microscopist and introduced important innovations in the field, according to T.G. Rochow and P. A. Tucker. Now we can switch to modern microscopes by simply introducing the papers realised for this special issue.

The inclusion of very different researchers in microscopy in the same issue reflects their common goals and their common way through the evolution of the shared methodology and vocabulary of electrical and electronic engineering and, in particular, of image processing. Image processing has significantly contributed to the comprehension of the structures and systems being studied. Computer processing has a very important role in the 3-D reconstruction and representation of images, whether obtained by optical microscopes, acoustic ones, or high resolution scanning probe microscopes. Unfortunately, due to time scheduling problems, a paper on atomic force microscopy is missing. It is a pity also because during this year (1994) Calvin Quate of Stanford University, the scientist behind acoustic and atomic force microscopes, became the R&D Magazine's Scientist of the Year. However, indications about atomic force microscopy can be found in the works presented here by Niek van Huslt and David Dunlap.

The first article in this issue is a historical review by William Aspry on the commercial development of an Electron Microscope in Japan. This note is largely based on an interview with two of the founders of JEOL, a very important microscope manufacturer in Japan. In the next paper Claus Jorgensen and his colleagues, working in the Briggs' team, describe the application of scanning acoustic microscopy in sonography related to the study of coronary artery wall topography and mechanical properties. The following article by Jorgen Assentoft, et al., of the O'Brien research group, continues this same theme on acoustic microscopy and discusses the utilisation of scanning laser acoustic microscopy for characterising individual layers of biological tissue. We move away from acoustic microscopy to scanning tunneling microscopy in the article by David Dunlap. This author elegantly reports how the STM can be used for investigating DNA structure and biological specimens. He also critically discusses the operating conditions and the sample preparation procedures. The fifth contribution, by Niek van Hulst and M. Moers, is a very comprehensive and outstanding article on the biological applications of near-field optical microscopy. This is a true optical microscopic technique, allowing fluorescence, absorption, reflection, and polarization contrast, with the additional advantage of nanometer lateral resolution, unlimited by diffraction, as reported by the authors themselves. Moreover, these authors present results of combined photon scanning tunneling microscopy and atomic force microscopy to Langmuir-Blodgett monolayers and chromosomes. Ted Young then reports about the use of a light microscope for the quantitative analysis of specimens. This technique requires, as reported by the author himself, an understanding of light sources, the specimen-light interaction, the characteristics of optics and of modern elctro-optical sensors, and the proper use of digital image processing. The article by Ken Castleman and his co-workers is concerned with fluorescence in situ hybridisation (FISH) image analysis. FISH is a key technique, rapidly expanding in medical research and clinical diagnosis Also, in this work the quantitative aspects are treated. The role of digital image analysis is outlined in the study of FISH specimens in several ways. A comparison of the performances of two restoration methods on the analysis of confocal images is then given by Geert van Kempen, Hans van der Voort and co-workers in their work. The comparison is done on the basis of some simulation experiments, together with restoration results of confocal images.

The Guest Editor with Claudia

Coherent methods in confocal microscopy is the theme of the following article by Tony Wilson. He presents a survey of new methods aimed at extending the imaging capabilities of the instruments. The last article, by Alberto Diaspro, et al., is concerned with optical sectioning techniques by means of wide-field and confocal optical microscopy. Examples are given on the 2D/3D characterization of biostructures and of cellular events.

This special issue owes its greatest debt to the authors, but its realisation would not have been possible without the patience of Job and the wisdom of Al Wald. So, I am indebted to him for his way of being and to my wife Teresa and my duugther Claudia for helping me simply and with love. Special thanks are for Alessandra Gliozzi, Ranieri Rolandi and their fantastic research team.