

A journal of histochemistry as a forum for non-histochemical scientific societies

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Abstract

Histochemical techniques are widely applied in biomedical research and, during the last twenty years, they were among the methods used in more than 590,000 scientific articles in indexed journals. However, a very small percentage of these papers were published in strictly histochemical journals. A possible strategy to widen the audience of the histochemical journals making them attractive to non-histochemist authors might be to publish and make open-access available the proceedings of the meetings and conferences of valued scientific societies whose fellows use microscopy and histochemistry in their experimental activity. In the last years' experience of the *European Journal of Histochemistry*, this approach was effective to increase the number of published articles on stem cells and development, connective tissue and nerve cell biology.

Introduction

Histochemical methods and techniques at light and electron microscopy have wide application in a great variety of subjects in biology and medicine,^{1,2} from basic cell biology in animals and plants,³ to zoology and botany, developmental biology, cytogenetics, functional and morbid anatomy, pathology,⁴ tumor cell biology,⁵ and so forth. Thus it is not surprising that histochemistry in all its aspects (basic histochemistry, immunohistochemistry, enzyme- and lectin histochemistry, *in situ* hybridization) have been used in more than 590,000 scientific articles published in indexed biomedical journals, during the last twenty years (source: <https://pubmed.ncbi.nlm.nih.gov/>).

The great majority (more than 98 %) of these articles have been published in non-histochemical journals: this confirms that histochemistry is a powerful (and often irreplaceable) tool for scientists with very different research interests and expertise,⁶

thanks to the ability histochemical techniques have to locate single molecular components *in situ*, *i.e.* in the spatial location where their structural and functional roles are exerted in cells, tissues and organs.⁷⁻⁹ On the other hand, this may also suggest that histochemical journals have progressively become less appealing for authors who may mistakenly see them as too technically-oriented.⁴

Raymond Coleman properly wrote⁵ “the contributions of histochemistry to cell and molecular biology are not always given the credit it deserves” being histochemistry often perceived as a methodological archaic discipline. In fact, the histochemical journals since their foundation (in the fifties of the last century, for the oldest ones) have surely been devoted to the development of original methods and techniques for detecting and dynamically track specific molecules, and to design novel applications on living organisms; however, as one may read in their aims and scope (see, *e.g.* ¹¹⁻¹⁵), the interest is explicitly expressed also for molecular and functional cytology and histology as well as for the mechanistic study of embryonic development, cell differentiation, and diseases. As such, the histochemical journals should naturally be a forum not only for the strict histochemical community, but also for a large and diverse range of scientists in biology and medicine.

A possible strategy to widen the audience of a histochemical journal

All over the world, most of the histochemical journals were founded by members of national Societies of histochemistry, or serve as their official organs: this is the case, *e.g.*, for Histochemistry (now Histochemistry and Cell Biology),¹¹ The Journal of Histochemistry and Cytochemistry,¹² Acta Histochemica et Cytochemica,¹³ Folia Histochemica et Cytobiologica,¹⁴ and the Rivista di Istochimica Normale e Patologica (now *European Journal of Histochemistry*)¹⁵. Thus, at least in principle, the Societies' fellows should primarily consider these journals for submitting their manuscripts; the journals, for their part, should promote diffusion of the associates' scientific results in view of the general progress of the discipline.

One of the ways to achieve this goal is to publish the proceedings of the Society meetings and conferences thus making them available to the scientific community: the *European Journal of Histochemistry*, for instance, has regularly published the congress proceedings of the Italian Society of Histochemistry from 1958¹⁶ (Figure 1) to present.¹⁷ These journal supplementary issues provide a detailed record on how his-

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tochemistry developed in Italy over the last sixty years, but were -at the time of their publication (and today as well)- a snapshot of the current state and interests of the histochemical research.

Since 2000, the policy of the *European Journal of Histochemistry* is to host the proceedings of symposia or conferences organized, under the auspices of the Italian Society of Histochemistry, by national research institutions or scientific societies. Among them, the Italian Embryological Group (now GEI-Italian Society of Development and Cell Biology, in 2016-18), the Italian Society for the Study of the Connective Tissue (2005, 2009-18), and the Italian Society of Neuromorphology (2013 and 2014). In addition, the abstracts of several scientific meetings were also published: the “Pavia symposium on embryos and stem cells”,¹⁸ the XXII Annual Meeting of the Italian Group for Ultrastructural Pathology,¹⁹ and the Conferences “Correlative Microscopy in Life and Materials Sciences”²⁰ and “Therapeutic nanoproducts: from biology to innovative technology”.²¹ In recent years, the national congresses of the Italian Society of Histochemistry have jointly been organized with the two other scientific Societies whose fellows have microscopy and histochemistry among the technologies and methods in their investigations:^{17,22,23} the GEI-Italian Society of Development and Cell Biology, in 2015 and 2019, and the Italian Society of Anatomy and Histology, in 2017.

These joint conferences as well as the other scientific events were the occasion for mutual exchange of information and for establishing research collaborations among histochemists and scientists from other disciplines; but they were they also important

for the journal were the proceedings were open-access published, as the journal website was visited by a number of new non-histochemist readers.

This was surely helpful to widen the journal's audience and a proof may be found browsing the journal regular issues in the period 2001-19, with attention to the articles on stem cells and development, the connective tissue, and nerve cells. The aggregate percentage of the paper published on these subjects has progressively increased from about 20% in 2001-10 to near 40% in 2017-19 (Figure 2).

It is worth noting that not only the number of papers on these subjects increased especially in recent years, but also -even more importantly- novel applications for the histochemical approach were proposed. As for development and stem cells, besides the descriptive papers of protein expression during embryogenesis under natural or experimental conditions,²⁴⁻³³ articles were published on the role of stem cells in the origin and progress of diseases^{34, 35} or on their application in regenerative medicine.³⁶⁻³⁸ On this last subject, the stem cells derived from the connective tissue (namely from the adipose tissue) proved to be especially promising.³⁹⁻⁴¹ Chondrogenesis and osteogenesis were investigated not only during normal embryological development but also in the attempt to elucidate the origin of joint diseases, such as osteoarthritis.⁴²⁻⁴⁶ Immunohistochemistry was essential to demonstrate the embryological origin of hemopoietic cells in non-mammalian vertebrates,^{47,48} and to describe the interaction of non-myelinating Schwann cells with immune cells in the mouse lymphoid organs.⁴⁹⁻⁵¹ The basic cell mechanisms of apoptosis and autophagy proved to play key roles during the pre- and postnatal development of the cochlea in rodents^{27,52,53} as well as during senescence in culture of sheep neurons and astrocytes.⁵⁴ The effect of cadmium was found to alter glial architecture in the lizard brain,⁵⁵ and to induce neurodegeneration in zebrafish embryos and adults,⁵⁶ while the effects of drug administration on the brain following trauma were studied in rat.⁵⁷ A modified method of combined fixation in formalin and formic acid was described to obtain high quality immunolabeling of long-stored paraffin-embedded autoptical adult brains,⁵⁸ and original staining protocols were proposed to visualize on thick brain sections the cortical microinfarcts that frequently remain undetected by standard neuroimaging protocols.⁵⁹

In spite of the present trend towards Big Data collection, there will always be the need for observation at the level of single tissue, single cell, single molecule.

Concluding remarks

The Editors of Histochemistry and Cell Biology recently reviewed the origin and evolution of their journal, recalling the 60th anniversary of its founding, in 1958:⁶⁰ while commenting the change of the journal's name from the original, Histochemistry to the pres-

ent one, they wrote "though the name may have changed to reflect the growth and maturation of both scientific publishing practices, as well as the science itself, the underlying objectives to publish high-quality manuscripts illustrating technical innovations in histochemistry and their application in original research in cell and molecular sciences have remained steadfast guiding principles".

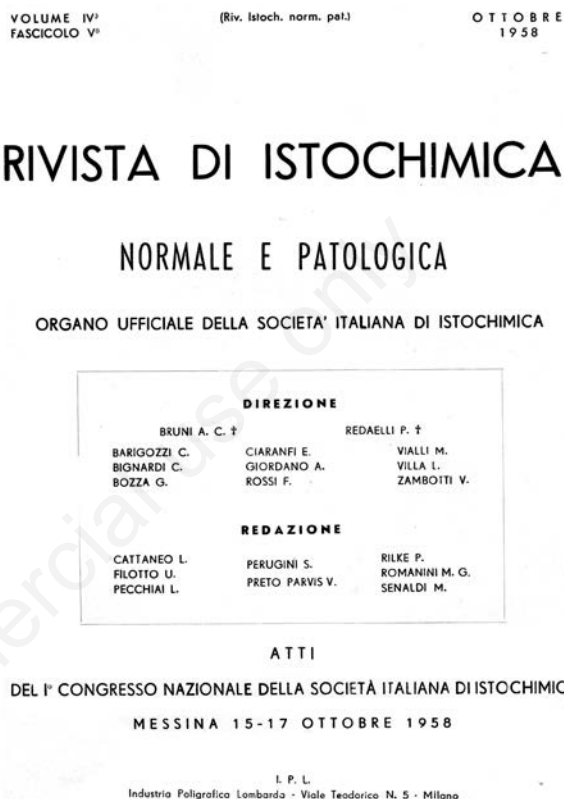


Figure 1. Front page of the fifth issue of Volume IV, 1958 of the journal *Rivista di Istochimica Normale e Patologica* where the proceedings of the 1st National Congress of the Italian Society of Histochemistry were published.

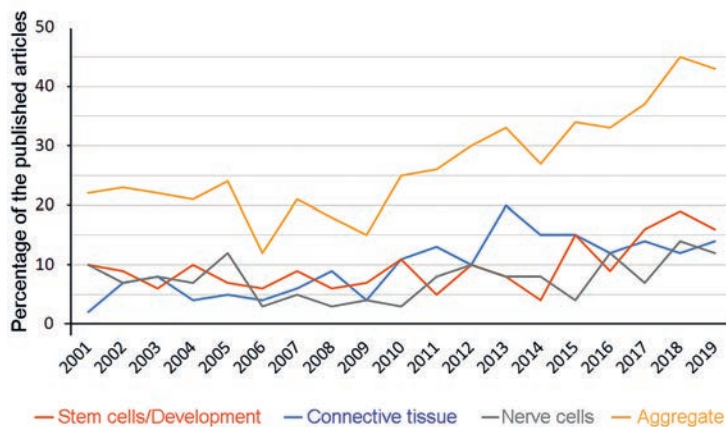


Figure 2. Percentage of the articles published in the *European Journal of Histochemistry* on stem cells and development, the connective tissue, and nerve cells in the period 2001-19.

Paraphrasing this sentence, one may say that the above-mentioned guiding principles of a trustworthy histochemical journal surely remain steadfast when opening the journal to high quality contributions by valued scientific societies that may help further widening the horizon of the histochemical science.

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