

Preface to the Special Issue in Memory of Prof. Gaetano Giaquinta

Original

Preface to the Special Issue in Memory of Prof. Gaetano Giaquinta / Federico, S., Grillo, A.. - In: MATHEMATICS AND MECHANICS OF SOLIDS. - ISSN 1081-2865. - STAMPA. - 25:5(2018). [10.1177/1081286518766746]

Availability:

This version is available at: 11583/2723263 since: 2023-06-26T15:41:53Z

Publisher:

SAGE PUBLICATIONS

Published

DOI:10.1177/1081286518766746

Terms of use:

This article is made available under terms and conditions as specified in the corresponding bibliographic description in the repository

Publisher copyright

Sage postprint/Author's Accepted Manuscript

(Article begins on next page)

Preface to the Special Issue in Memory of Prof. Gaetano Giaquinta (1945-2016)

Salvatore Federico^a and Alfio Grillo^b

^a Department of Mechanical and Manufacturing Engineering, The University of Calgary
2500 University Drive NW, Calgary, Alberta, T2N 1N4, Canada
Tel: +1-403-220-5790, Fax: +1-403-282-8406, Email: salvatore.federico@ucalgary.ca

^b Dipartimento di Scienze Matematiche “G.L. Lagrange”, Politecnico di Torino
Corso Duca degli Abruzzi 24, 10129 Torino, Italy
Tel: +39-011-090-7531, Fax: +39-011-090-7599, Email: alfio.grillo@polito.it

Mathematics and Mechanics of Solids, 2020, Vol. 25(5), 1042-1045

DOI: 10.1177/1081286518766746

Published online 2018-05-11

1 This special issue of *Mathematics and Mechanics of Solids* is dedicated to the memory of our *maestro* and
2 mentor Gaetano Giaquinta, Professor of Structure of Matter at the University of Catania, Italy, who passed
3 away on the 13th of August 2016, after a long battle against cancer.

4 Gaetano Giaquinta was born in Catania, Italy, on the 28th of November 1945, and received his *laurea* in
5 Physics on the 20th of November 1968, after defending a thesis entitled “*Josephson Currents in Superconducting*
6 *Junctions with a non-Conventional Insulator*” [1]. With his pioneering work, Gaetano Giaquinta was the one
7 who initiated the research on Superconductivity at the University of Catania [2].

8 Since the early years of his career, the scientific and academic life of Gaetano Giaquinta was characterised
9 by many recognitions both at the national and at the international level. From 1972 to 1991, he held numerous
10 invited seminars and lectures in congresses, workshops, international schools, and prestigious universities and
11 scientific institutions. Moreover, from 1969 to 2013, he authored several articles and monographs, published in
12 scientific journals and book series.

13 Having been educated as a theoretical physicist with a strong background in Quantum Mechanics and,
14 in particular, in Structure of Matter and Solid State Physics, Gaetano Giaquinta’s main scientific interests
15 were electronic tunnelling and phonon spectroscopy, thermodynamic fluctuations of the order parameter in
16 superconductors of type I, excitonic superconductivity in metal-dielectric coupled systems and in biological
17 systems, Kosterlitz-Thouless-Berezinskii transitions in two-dimensional superconductors, granular and meso-
18 scopic superconductors, quantum size effect in degenerate semiconductors, high temperature superconductivity,
19 vortex-antivortex pair dissociation in two-dimensional superconductors and gauge theories. From 2002 to 2009,
20 his research turned to Continuum Mechanics and Biomechanics and, in particular, to problems involving growth,
21 remodelling and transport phenomena in biological tissues. The last years of his scientific activity, from 2009
22 to 2012, were devoted to some fundamental aspects of Analytical Mechanics and Electromagnetism. He served
23 the scientific community as an organiser of symposia and conferences, as a reviewer for scientific journals and
24 as a book editor.

25 Our relationship with Prof. Giaquinta started with him as the Physics professor whom everyone was talking
26 about, and us as undergraduate students, and then evolved into a relationship of research collaboration and,
27 naturally, as the very strong friendship between a professor and his last disciples.

28 In his career as a professor at the University of Catania, Prof. Giaquinta taught several courses of Physics
29 in different study programmes, these ranging from Medicine to Geology, Physics and Engineering. His “home-
30 faculty”, however, was the Faculty of Engineering, where he felt that he had the mission of “making” engineers.
31 His idea was that each student had to be a person of culture and an intellectual. In his courses of Physics I
32 (Mechanics and Thermodynamics), Physics II (Electromagnetism), Structure of Matter and Solid State Physics,
33 he polarised his audience. Faithful to the Latin etymology *universitas studiorum* (the *totality* of the possible
34 courses of study) of “university”, he would enrich his Physics classes with Philosophy, Literature, History, Art,
35 Latin and Greek. Most students continuously showed manifestations of sheer love for him, even though some
36 others could just not get used to his eclectic teaching style. Many were those students who came all the way
37 from other programmes and even other faculties to attend a lecture of this “living legend”.

38 The list of anecdotes on Prof. Giaquinta's lectures is virtually endless, and we shall report just a few. At
39 the beginning of each course, he used to state that:

40 *"The course is based on three principal languages and one auxiliary language. The principal ones*
41 *are Latin, Sicilian and English. The auxiliary one is Italian."*

42 Although he was exaggerating, some lectures were really like that, and for most students those were the most
43 memorable. One of the first questions that he would ask his students in the first lecture of a course was: *"What*
44 *is a vector?"*, to which there was always that diligent, but unlucky student, who would confidently answer: *"An*
45 *entity endowed with magnitude, direction and sense!"*. At that point Prof. Giaquinta would smile and say: *"No,*
46 *my dear: it is an element of a vector space"*.

47 Sometimes, during oral exams (which were normal examination practice in Italy), Prof. Giaquinta would
48 take his copy of *Mechanics* [3] or of *The Classical Theory of Fields* [4] by Landau and Lifshitz and would tell
49 the examinee:

50 *"Swear on Landau's book that you shall not say nonsense!"*

51 Once, he asked a student to enunciate the Second Principle of Thermodynamics. The student had stumbled
52 into a topic that he had not quite understood, but quite confidently recited that *"it is impossible to transfer*
53 *heat from a low-temperature body to a high-temperature body"*. Prof. Giaquinta patiently tried to guide him
54 towards the correct answer, but the student continued rephrasing exactly the same idea over and over again,
55 until Prof. Giaquinta exclaimed:

56 *"Spontaneously! You must add spontaneously! Otherwise it means that the electric company is*
57 *stealing your money to make your fridge work!"*

58 In love with Analytical Mechanics, in his lectures he always cited Lagrange's *Mécanique Analytique* and the
59 works by Maupertuis, Poisson, D'Alembert and Hamilton, and he educated his students since the first-year
60 Physics I course to Lagrangian and Hamiltonian Mechanics. Two of his favourite mottoes were *"Physics—*
61 *where the Action is!"* [5] and the quotation of Dirac's sentence: *"[...] there are reasons for believing that the*
62 *Lagrangian one [formulation] is the most fundamental"* [6]. His first lecture in any of his courses would always be
63 on Hamilton's Principle of Stationary Action, the search for extrema of the action functional and the derivation
64 of the Euler-Lagrange equations. Thus, for all of his students, the basics of Mechanics and Electromagnetism
65 coincided with the Euler-Lagrange equations associated with the Lagrangian function of the problem at hand.
66 Furthermore, the key-concepts of modern physics known as gauge theories, symmetry breaking and its dynamic
67 restoring were always present in his speeches and lectures.

68 After a pause from scientific life due to severe health problems, Prof. Giaquinta returned on the stage of
69 science in 2002 and then, until 2012, he was again surrounded by *Laurea* and PhD students. This last period of
70 his activity started with Alfio Grillo (AG), who was his *Laurea* and PhD student as well as post-doctoral fellow,
71 and continued with Dr. Giandomenico Zingali, Diego M. Borrello, Dr. Marco Caruso and Marco Coco. All
72 through these years, Salvatore Federico (SF) was a faithful and permanent "tangential affiliate" of the group.

73 Around 2002, in fact, Prof. Giaquinta's career as a theoretical physicist had an unexpected shift from
74 Quantum Mechanics to Continuum Mechanics. At that time, we (SF and AG) were moving our first steps in
75 this field. Prof. Giaquinta guided us from the vantage point of an experienced researcher, professor and mentor.
76 This all started when AG was working on a growth mechanics problem that had been suggested by Prof. Marcelo
77 Epstein (The University of Calgary) and SF. With the idea of reinterpreting the results of Prof. Marcelo Epstein
78 and Prof. Gérard A. Maugin [7] under the light of the methods of Classical Field Theory acquired from the
79 lectures held by Prof. Giaquinta, AG and SF turned to Prof. Giaquinta for advise and help. As an expert of
80 the subject, he offered his supervision and, with the collaboration of Prof. Walter Herzog (The University of
81 Calgary) and Prof. Guido La Rosa (University of Catania), we produced our first team work [8].

82 Some years later, while AG was a PhD student of Prof. Giaquinta, SF invited AG and Prof. Giaquinta
83 to contribute to his research project on the microstructural modelling of articular cartilage (this project was
84 conducted in collaboration with Prof. Walter Herzog and Prof. Guido La Rosa). In 2004, during a meeting
85 that involved SF, Dr. Sang-Kuy Han (at the time, visiting PhD student at the University of Catania from
86 Prof. Herzog's group), AG and Prof. Giaquinta, SF showed an image that reported the distribution of the
87 orientation of the collagen fibres in a sample of articular cartilage. Together with that image, which was obtained

88 experimentally, SF also showed an empirical curve of sigmoidal shape that described the mean orientation angle
89 of the collagen fibres as a function of the coordinate running from the bone-cartilage interface to the articular
90 surface. When Prof. Giaquinta saw those figures, he exclaimed:

91 “This is a structural phase transition and it has to be describable by a Ginzburg-Landau free energy
92 ...”

93 The suggestions given by Prof. Giaquinta were very useful for producing our first team work on a microstruc-
94 turally consistent mechanical model of articular cartilage [9]. However, the model of articular cartilage based
95 on the Ginzburg-Landau free energy [10, 11] became reality only many years later and after several discussions
96 between AG and Prof. Giaquinta. This model led to a “conclusive” team work on the subject, authored by AG,
97 SF and Dr. Melania Carfagna (AG’s former PhD student) [12].

98 Although Prof. Giaquinta could dedicate to Continuum Mechanics only the last years of his career, his
99 interest for this field of research made him undertake the organisation of the eighth edition of the international
100 seminar *Geometry, Continua and Microstructure - GCM8*, which was held in Catania, Italy, from the 10th to the
101 12th of October 2008 (www.dmfc.unict.it/users/gcm8/). Together with Prof. Gérard A. Margin, Prof. Milan
102 V. Mićunović and Prof. Robin W. Tucker, he edited the collection of contributed papers “Geometry, Continua
103 and Microstructure 2008, *Il Nuovo Cimento C* of the *Società Italiana di Fisica* (Italian Physical Society)”,
104 published in 2009 (www.sif.it/riviste/ncc/econtents/2009/032/01).

105 From 2009, Prof. Giaquinta was corresponding member of the *Accademia Peloritana dei Pericolanti* of
106 Messina, Italy, (ww2.unime.it/accademiapeloritana/) and, in the last years of his life, he continued his commit-
107 ment to promote science, art and culture in general as Chair of the scientific committee of the Floresta Longo
108 Foundation (<http://en.fondazioneflorestalongo.it>) (Catania, Italy).

109 What made a great man out of Prof. Giaquinta was his need to transmit his huge culture to the younger
110 generations. In fact, he “professed” Physics, and he did it for his students. The most important recipients of
111 his cultural message were in fact the young people that were around him in his lectures or in the corridors of
112 the Faculty of Engineering. To them he devoted his life, while talking about the beauties of Physics and the
113 challenge of discovering its fundamental laws in a poem or a painting.

114 Among the last disciples of Prof. Giaquinta, we are so far the only ones who have pursued an academic
115 career. We therefore felt that it was our duty to pay this tribute to our *maestro*, who has so deeply influenced
116 our way to conceive science and life.

117 In this special issue, we have five contributions. Cuomo [13] proposes to describe scale effects in plasticity
118 by means of a second-gradient material model, which employs different evolution laws at the microscopic and
119 macroscopic scales; the model is aimed at the study of metamaterials. Epstein and de León [14] provide an
120 introduction to the use of the differential geometrical concepts of Lie groupoids and Lie algebroids in Contin-
121 uum Mechanics for the description of material properties and material defects, respectively. Mićunović and
122 Kudrjavceva [15] use the effective field approach to retrieve the fourth-order elasticity tensor and to study
123 the damage evolution of a composite with a void phase and a short fibre phase, with an application to the
124 damage-elasto-viscoplastic strain of an industrial steel. Lo Giudice et al. [16] present a mathematical model
125 aimed at reproducing the kinematic evolution of the surface of sand piles and dunes and at predicting stationary
126 configurations; the study is corroborated by a comparison with experimental results. Wittum et al. [17] study
127 a model of the barrier function of the skin tissue, by treating the extracellular space with full spatial resolution,
128 considering the cells being of both hexagonal prismatic shape and tetrakaidekahedral shape, and considering
129 vertical cell stacking.

130 We would like to close this Preface with a quote from Prof. Giaquinta, which may help the Readers understand
131 the man he was (this quote can be found in the website www.tonymicotra.it, of the Italian painter Tony Nicotra):

132 “*Art and Quantum Dynamics, complementary fields that reflect the reality of universal symmetry.*”

133 References

- 134 [1] G. Giaquinta. *Correnti Josephson in Giunzioni Superconduttrici con Isolante non-Convenzionale*. Laurea
135 Thesis, University of Catania, 1968. In English: *Josephson Currents in Superconducting Junctions with a*
136 *non-Conventional Insulator*.

- 137 [2] The information contained in this Preface is extracted from Prof. Giaquinta's *Curriculum Vitae et Studio-*
138 *rum*, available on line at <http://fondazioneflorestalongo.it/team/gaetano-giaquinta/>, and from
139 our personal knowledge of Prof. Giaquinta.
- 140 [3] L. D. Landau and E. M. Lifshitz. *Mechanics*. Pergamon Press, Oxford, UK., 1960.
- 141 [4] L. D. Landau and E. M. Lifshitz. *The Classical Theory of Fields*. Pergamon Press, Oxford, UK., 1960.
- 142 [5] A. Watson. Physics – where the action is. *New Scientist*, 30 January 1986, 42–44.
- 143 [6] P.A.M. Dirac. The Lagrangian in Quantum Mechanics. *Physikalische Zeitschrift der Sowjetunion*, 3(1),
144 64–72 (1933).
- 145 [7] M. Epstein and G.A. Maugin. Thermomechanics of volumetric growth in uniform bodies. *International*
146 *Journal of Plasticity*, 16, 951–978 (2000).
- 147 [8] A. Grillo, S. Federico, G. Giaquinta, W. Herzog, G. La Rosa. Restoration of the symmetries broken by
148 reversible growth in hyperelastic bodies. *Theoretical and Applied Mechanics*, 30(4), 311–331 (2003).
- 149 [9] S. Federico, A. Grillo, G. La Rosa, G. Giaquinta, W. Herzog. A transversely isotropic, transversely homoge-
150 neous microstructural-statistical model of articular cartilage. *Journal of Biomechanics*, 38(10), 2008–2018
151 (2005).
- 152 [10] V.L. Ginzburg, L.D. Landau. On the theory of superconductivity. *Zhurnal Éksperimental'noĭ Teoreticheskoi*
153 *Fiziki*, 20, 1064–1082 [published in English in: Landau LD collected papers. Pergamon Press, Oxford (1965),
154 546]
- 155 [11] V.L. Ginzburg. On superconductivity and superfluids. In: Nobel Lecture, p. 96–127 (2003)
- 156 [12] A. Grillo, M. Carfagna, S. Federico. An Allen-Cahn approach to the remodelling of fibre-reinforced
157 anisotropic materials. *Journal of Engineering Mathematics*, 109, 139–172 (2018).
- 158 [13] M. Cuomo. Continuum model of microstructure induced softening for strain gradient materials. *Mathe-*
159 *matics and Mechanics of Solids*, 24(8), 2374–2391 (2019).
- 160 [14] M. Epstein, M. de León. Material groupoids and algebroids. *Mathematics and Mechanics of Solids*, 24(3),
161 796–806 (2019).
- 162 [15] M. Mićunović, L. Kudrjavceva. On inelasticity of damaged quasi rate independent anisotropic materials.
163 *Mathematics and Mechanics of Solids*, 24(3), 778–795 (2019).
- 164 [16] A. Lo Giudice, G. Giammanco, D. Fransos, L. Preziosi. Modelling sand slides by a mechanics-based
165 degenerate parabolic equation. *Mathematics and Mechanics of Solids*, 24(8), 2558–2575 (2019).
- 166 [17] R. Wittum, A. Naegel, M. Heisig, G. Wittum. Mathematical modelling of the viable epidermis: Impact of
167 cell shape and vertical arrangement. *Mathematics and Mechanics of Solids*, 25(5), 1046–1059 (2020).