Ten Years of Progress in the ICRU Program

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Introduction

During the ten-year period 1989 - 1998, the International Commission on Radiation Units and Measurements (ICRU) made important progress in the areas of publication of ICRU reports, the establishment of ICRU NEWS as an important element in the Commission's program and the initiation of new scientific activities. The breadth of the Commission's program in each of these areas is considerable but for purposes of analysis, it appears useful to examine each of these areas in terms of various categories into which the Commission's program might be divided. An appropriate, if somewhat arbitrary, set of categories might be the following:

Physics and data

Radiotherapy

Imaging

Radiation protection

Nonionizing radiation.

This set of categories can be used to examine ICRU activities during the last ten years related to publication of reports, publication of major articles in ICRU NEWS and the initiation of new scientific activities.

ICRU Reports

In the last ten years, the ICRU has published 18 ICRU reports. The breakdown of these into the selected categories is shown in Table 1. (A full listing of the Reports published during that time is set out in the Annex of this article.) It is not surprising that the category physics and data has the greatest number of entries since the ICRU's concern has always been with the physics of quantities, units and measurements relevant to radiation science. While the categories of imaging and nonionizing radiation are sparsely populated, it should be noted that during this period, these areas represented fields being examined as potential targets for expansion of the Commission's program, as will be noted in connection with the discussion of the initiation of new activities (see below).
ICRU NEWS

The decision to begin the publication of ICRU NEWS in 1989 represented a milestone in the development of the Commission's program. The goal was to provide a vehicle by which information about the ICRU, its interests and activities could be made available to those interested in the Commission's work. A particular emphasis was to be placed on the provision of information about the publication of new reports, work nearing completion and new programs being initiated.

Table 1: Categorization of ICRU Reports published during the period 1989 - 1998 (for a full listing see the Annex)

<table>
<thead>
<tr>
<th>Year</th>
<th>Physics &amp; Data</th>
<th>Radiotherapy</th>
<th>Imaging</th>
<th>Rad. Protect.</th>
<th>Non-ionizing Rad.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>1990</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
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<tr>
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<tr>
<td>1992</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>1993</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>1994</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
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<tr>
<td>1995</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>1996</td>
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<td>-</td>
<td>-</td>
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<td>-</td>
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<tr>
<td>1997</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>1998</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
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<td>4</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>18</td>
</tr>
</tbody>
</table>

During these first ten years of publication of ICRU NEWS, 76 major articles were published (see the Annex for a full list). The breakdown of these into the selected categories is shown in Table 2. Again, the emphasis on physics and data is evident, but now the category "imaging" emerges as a major element, foreshadowing the expansion in the Commission's program exhibited in the initiation of new activities to be discussed below.

Initiation of New Scientific Activities

The ICRU has always sought to be on the alert for areas where the initiation of new activities might constitute an important contribution to progress in radiation science. In recent years, these efforts to examine potential new activities have frequently employed seminars held at Commission meetings and aimed at surveying the status of a given field, the need for ICRU activities and the form of any proposed ICRU undertaking, usually the constitution of a new report committee to begin the drafting of a new ICRU report. During the period surveyed here, 19 new report committees have been constituted. The categorization of these is shown in Table 3. (A full listing is set out in the Annex.) It can be seen that here, the categories denominated as imaging, radiotherapy and radiation protection are dominant, reflecting, at least in the case of new work on imaging, the Commission's specific decision to expand the program in this area. The paucity of new activities in the area of nonionizing radiation is reflective of the Commission's unwillingness to embark on a large scale expansion in this area but rather to limit ICRU activities to specific cases where a strong need is evident.
Table 2: Categorization of major articles published in ICRU NEWS during the period 1989-1998 (for a full listing see the Annex)

<table>
<thead>
<tr>
<th>Year</th>
<th>Physics &amp; Data</th>
<th>Radiotherapy</th>
<th>Imaging</th>
<th>Rad. Protect.</th>
<th>Non-ionizing Rad.</th>
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<tr>
<td>1989</td>
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<td>1991</td>
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<td>1992</td>
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<td>3</td>
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<tr>
<td>1995</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>11</td>
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<tr>
<td>1996</td>
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<td>1</td>
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<td>1</td>
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<td>5</td>
</tr>
<tr>
<td>1997</td>
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<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>4</td>
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<td>1998</td>
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<td>1</td>
<td>1</td>
<td>2</td>
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<td>5</td>
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<tr>
<td>Total</td>
<td>32</td>
<td>11</td>
<td>19</td>
<td>11</td>
<td>3</td>
<td>76</td>
</tr>
</tbody>
</table>

Table 3: Categorization of new scientific activities initiated during the period 1989-1998 (for a full listing see the Annex)

<table>
<thead>
<tr>
<th>Year</th>
<th>Physics &amp; Data</th>
<th>Radiotherapy</th>
<th>Imaging</th>
<th>Rad. Protect.</th>
<th>Non-ionizing Rad.</th>
<th>Total</th>
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<tbody>
<tr>
<td>1989</td>
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<td>-</td>
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<tr>
<td>1990</td>
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<tr>
<td>1991</td>
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<td>-</td>
<td>3</td>
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<tr>
<td>1992</td>
<td>-</td>
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<td>-</td>
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<td>-</td>
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<td>6</td>
<td>5</td>
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<td>19</td>
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</table>

Overall Evaluation

Combining the information set out in Tables 1, 2, and 3, it is possible to perform an overall evaluation of the development of the Commission's program during the last ten years in the areas of publication of reports, ICRU NEWS and initiation of new activities. The resultant categorization is set out in Table 4 which provides evidence that the Commission has made important progress in each of these areas in its efforts to meet its basic responsibility to provide a consensus of leading international scientific thinking on matters of radiation quantities, units and measurement.
Table 4: Categorization of Reports and articles published and new scientific activities initiated during the period 1989 - 1998

<table>
<thead>
<tr>
<th>Year</th>
<th>Physics &amp; Data</th>
<th>Radiotherapy</th>
<th>Imaging</th>
<th>Rad. Protect.</th>
<th>Non-ionizing Rad.</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>1989</td>
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<td>1992</td>
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<td>26</td>
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</table>

Annex: ICRU Reports and Major Articles Published and New Scientific Activities Initiated During the Period 1989-1998

Physics and Data:

ICRU Reports


48  *Phantoms and Computational Models in Therapy, Diagnosis and Protection* (1992)

49  *Stopping Powers and Ranges for Protons and Alpha Particles* (1993)

52  *Particle Counting in Radioactivity Measurement* (1994)


60  *Fundamental Quantities and Units for Ionizing Radiation* (1998)

ICRU NEWS

80 Years of Radiation Quantities and Units - Personal Reminiscences. Part I: From a Variety of Radiation Units to the International Standards by L. S. Taylor (June 1989)

80 Years of Radiation Quantities and Units - Personal Reminiscences. Part II: From the
'International X-Ray Unit Committee' to the International Commission on Radiation Units and Measurements by L. S. Taylor (June 1990)

ICRU Report on Stopping Power for Protons and Alpha Particles by M. J. Berger (June 1989)

Phantoms in Therapy, Diagnosis and Protection by D. R. White (June 1989)

Tissue Substitutes in Radiation Dosimetry and Measurement by D. R. White (June 1989)

Radiation Quantities and Units by H. O. Wyckoff (December 1989)

Fundamentals of Particle Counting Applied to Radioactivity Measurements by J. W. Müller (December 1989)

Hyperthermia: The Problem of Clinically Meaningful Dose by G. M. Hahn (June 1990)

Spectra of Secondary Electrons from Electron and Proton Collisions by M. E. Rudd (June 1990)

Stopping Power for Heavy Ions by P. Sigmund (June 1990)

Rigour Within Uncertainty - The Need for a Strict Definition of the Quality Factor by A. M. Kellerer (December 1990)

About Absorbed Dose by H. H. Rossi (December 1990)

Gamma-Spectrometry in the Environment by P. Jacob (December 1990)


Phantoms and Computational Models in Therapy, Diagnosis and Protection by D. White (June 1991)

Antiprotons Considered as a Subject of Radiation Physics by M. Inokuti (June 1991)

In Situ Gamma Spectrometry in the Environment by P. Jacob (December 1991)

25 Years of Ionizing Radiation Metrology, 1960 - 1985 - Part I: Search For Coherence of Measurements by A. Allisy (December 1991)

25 Years of Ionizing Radiation Metrology, 1960 - 1985 - Part II: Research Work at BIPM by A. Allisy (June 1992)

The Design and Manufacture of Anthropomorphic Phantoms by D. R. White (June 1992)


Absorbed Dose Standards for Photon Irradiation and Their Dissemination by K. Hohlfeld (June 1993)
Secondary Electron Spectra Resulting from Charged Particle Interactions by M. E. Rudd (June 1993)


Assessment of Uncertainties in Measurements by A. Allisy and J. W. Müller (December 1994)

Why Cema? by H. H. Rossi and A. M. Kellerer (December 1994)

Secondary Electrons Resulting From Charged-Particle Interactions by M. Inokuti and M. E. Rudd (December 1994)

ICRU Activities Concerned with Radiation in Science by M. Inokuti (June 1995)

ICRU Activities Concerned with Measurement of Radiation by H. H. Rossi and R. S. Caswell (June 1995)

ICRU Report 52: Particle Counting in Radioactivity Measurements by J. W. Müller (June 1995)

Absorbed Dose Standards for Photon Irradiation and Their Dissemination by K. Hohlfeld and M. Inokuti (December 1995)

Nuclear Data Needed for Fast Neutron and Proton Radiation Therapy by P. M. DeLuca, Jr., A. Wambersie and R. S. Caswell (June 1996)

New Activities

In Situ Gamma Spectrometry in the Environment (1989)

Nuclear Data for Dosimetry (1995)

Radiotherapy:

ICRU Reports


50  Prescribing, Recording and Reporting Photon Beam Therapy (1993)

58  Dose and Volume Specification for Reporting Interstitial Therapy (1997)


ICRU NEWS
Studies on Radiation Effects on DNA in Aqueous Solution by D. Schulte-Frohlinde (December 1989)


About Absorbed Dose Specification in Nuclear Medicine by P. K. Leichner (December 1991)

ICRU Report 50: Prescribing, Recording and Reporting Photon Beam Therapy by T. Landberg and A Wambersie (December 1993)

ICRU Activities Concerned with Radiotherapy by A. Wambersie and G. F. Whitmore (June 1995)

The Gray, and Blue Sky by H. Rodney Withers (December 1995)


Dose and Volume Specification for Reporting Interstitial Therapy by A. Wambersie (June 1997)

Application of ICRU Report 50 by L. Ekberg, O. Holmberg, L. Wittgren, G. Bjelkengren, T. Landberg and A. Wambersie (December 1997)


New Activities

Prescribing, Recording and Reporting Electron Beam Therapy (1991)

Medical Applications of Beta Rays (1991)

Radiobiological and Beam Quality Aspects of Proton Therapy (1995)

Dose and Volume specification for Reporting Intracavitary Therapy in Gynecology (1997)

Dose Specification in Nuclear Medicine (1997)

Imaging:

ICRU Reports
54  Medical Imaging - The Assessment of Image Quality (1995)

ICRU NEWS

Image Perception and Performance Assessment in Digital Imaging by P. F. Sharp (June 1989)

Image Quality: An Overview by P. F. Sharp (December 1989)

Image Display in Two and Three Dimensions by D. C. Barber (December 1989)

Quality of the Observed Image by C. E. Metz (December 1989)

Quality of the Acquired Data by R. F. Wagner, K. J. Myers, A. E. Burgess and D. G. Brown (December 1989)

Image Perception: The Problem as Perceived by the Radiologist by I. Isherwood (June 1990)

Quantitative Assessment of Image Representation by P. F. Sharp and J. R. Mallard (June 1990)

Computer-Aided Diagnosis (CAD) Schemes Based on Quantitative Analysis of Digital Radiographic Images by K. Doi (June 1991)

Patient Dosimetry in Diagnostic Radiology by P. J. Roberts (December 1992)

Registration of Three-Dimensional Medical Image Data by Ch. Pelizza (June 1994)

ICRU Activities in Medical Imaging by K. Doi (June 1994)

Medical Imaging -- The Assessment of Image Quality by P. F. Sharp (June 1994)

ICRU Activities Concerned with Dosimetry for Diagnostic Medicine by P. M. DeLuca and L. E. Feinendegen (June 1995)

ICRU Activities Concerned with Medical Imaging by I. Isherwood and K. Doi (June 1995)

Perspectives on Digital Analysis in Medical Imaging: Needs for a New Science Concerning Technical Understanding of the Contents of Medical Images by K. Doi (June 1996)

Mammography - Assessment of Image Quality by M. J, Yaffe (December 1996)

Receiver Operating Characteristic (ROC) Analysis in Medical Imaging by C. E. Metz (June 1997)

Bone Densitometry and Morphometry by W. A. Kalender and K. Engelke (December 1997)

Chest Radiography - Assessment of Image Quality by C. Vyborny (December 1998)

New Activities
ROC analysis (1991)

Mammography - Assessment of Image Quality (1993)

Dosimetric Procedures in Diagnostic Radiology (1993)

Chest Radiography - Assessment of Image Quality (1996)

Assessment of Image Quality in Nuclear Medicine (1997)

Bone Densitometry (1997)

**Radiation Protection:**

**ICRU Reports**


51 *Quantities and Units in Radiation Protection Dosimetry* (1993)

56 *Dosimetry of External Beta Rays for Radiation Protection* (1997)

57 *Conversion Coefficients for use in Radiological Protection Against External Radiation* (1998)

**ICRU NEWS**


*There is Hardly One Sievert* by H. H. Rossi (December 1991)

*Dosimetry of External Beta Rays for Radiation Protection* by W. G. Cross (June 1993)

*ICRU Report 51: Quantities and Units in Radiation Protection Dosimetry* by W. A. Jennings (December 1993)

*The Quantification of Physical Events within Tissue at Low Levels of Exposure to Ionizing Radiation* by L. E. Feinendegen, V. P. Bond and J. Booz (December 1994)

*ICRU Activities Concerned with Dosimetry for Radiation Protection* by H. G. Menzel and L. E. Feinendegen (June 1995)

*ICRU Activities Concerned with Radiation in the Environment* by H. G. Paretzke (June 1995)
Conversion Coefficients for External Radiations by R. H. Thomas and M. J. Clark (June 1996)

Radiation Protection and Radiation Measurement by C. B. Meinhold (June 1998)


New Activities

Beta Ray Dosimetry for Radiation Protection (1990)

Determination of Body Burdens for Radionuclides (1990)

Requirements for Radiological Sampling (1994)


Retrospective Assessment of Exposure to Ionizing Radiation (1997)

Nonionizing Radiation:

ICRU Reports

61  Tissue Substitutes, Phantoms and Computational Modelling in Medical Ultrasound (1998)

ICRU NEWS

Applications, Dosimetry and Biological Interactions of Static and Time-Varying Magnetic Fields by T. S. Tenforde (June 1989)

Tissue Substitutes and Phantoms for Ultrasound by D. R. White (December 1991)

Tissue Substitutes, Phantoms and Computational Modelling in Medical Ultrasound by A. C. Fairhead (June 1990)

New Activities

Tissue Substitutes, Characteristics of Biological Tissue and Phantoms for Ultrasound (1990)