PARTICLES

sponsored by

PROTON THERAPY CO-OPERATIVE GROUP

A Newsletter for those interested in proton, light ion and heavy charged particle radiotherapy.

Number 20 July 1997 Editor: Janet Sisterson Ph.D., HCL

Mailing Lists: It is time to update the mailing list. You **MUST** send back the **enclosed form OR** send e-mail to **ptcog@huhepl.harvard.edu** to stay on the mailing list. DO NOT SEND E-MAIL TO ME!!! PLEASE update your address, telephone and fax numbers and e-mail addresses.

Costs: At PTCOG XIX, the Steering Committee decided that part of the registration fee for PTCOG meetings would be used to help produce both Particles and the abstracts of the PTCOG meetings. Only part of the costs are covered in this way, so more financial help is needed from the community. HCL is always happy to receive financial gifts; all such gifts are deductible as charitable contributions for federal income tax purposes. The appropriate method is to send a check made out to the "Harvard Cyclotron Laboratory". We thank Steve Goetsch for his kind contribution.

Facility and Patient Statistics: I am still collecting information about all operating and proposed facilities, regarding patient statistics, machine scheduling, and treatment characteristics. Please send me up-to-date information.

Particles on the Internet: We have set up a home page for the Harvard Cyclotron Laboratory on the Internet from which you can access recent issues of Particles.

- To find Particles use the URL for the Harvard Cyclotron Laboratory:-
  http://neurosurgery.mgh.harvard.edu/hcl/ or
  http://brain.mgh.harvard.edu:100/hcl

Other proton therapy links: (this list is probably not complete, so PLEASE send me your URL to include in the next issue)

- Northeast Proton Therapy Center: http://www.mgh.harvard.edu/depts/nptc/index.html
- LLUMC, California: http://www.llu.edu/proton
- U of California, Davis: http://crocker.ucdavis.edu/cnl/research/eyet.htm
- Indiana University: http://nike.iucf.indiana.edu/ptherapy/
- TRIUMF, Canada protons: http://www.triumf.ca/welcome/proton_thrpy.html
- TRIUMF, Canada pions: http://www.triumf.ca/welcome/pion_trtmt.html
- NAC, South Africa: http://www.nac.ac.za/~medrad/index.html

- KVI, The Netherlands: http://www.kvi.nl/disk$1/protonlib/www/homepage.html
- PSI, Switzerland: http://www1.psi.ch/www_asm_hn/asm_home_page.html
- Tsukuba, Japan: http://www-medical.kek.jp/index.html
- Tsukuba, Japan - new facility plans: http://www-medical.kek.jp/devnewfac.html
- HIMAC, Chiba, Japan: http://www.nirs.go.jp/eng/particl.htm

ARTICLES FOR PARTICLES 21

The **deadline for news for Particles 21,** the January 1998 issue, is **November 30 1997**. I will send reminders by fax or e-mail.

Address all correspondence for the newsletter to:

Janet Sisterson Ph.D.
Harvard Cyclotron Laboratory
44 Oxford Street
Cambridge MA 02138

Telephone: (617) 495-2885
Fax: (617) 495–8054
E-mail: SISTERSON@HUHEPL.HARVARD.EDU

Articles for the newsletter can be short but should **NOT** exceed two pages in length. The best way to send an article is by computer. If you mail or fax an article, remember that I scan them into the computer so I need a good clean copy of any figures.

PTCOG and FUTURE PTCOG MEETINGS

Chair: Michael Goitein
Department of Radiation Oncology
Massachusetts General Hospital
Boston MA 02114

Secretary: Janet Sisterson
Harvard Cyclotron Laboratory
44 Oxford Street
Cambridge MA 02138

Steering Committee Members

USA	Europe	Russia	Japan	South Africa
J. Castro	U. Amaldi	V. Khoroshkov	K. Kawachi	D. Jones
W. Chu	H. Blattmann		H. Tsujii	
M. Goitein	J.-L. Habrand			
D. Miller	G. Munkel			
J. Sisterson	E. Pedroni			
James Slater	A. Wambersie			
A. Smith				
L. Verhey				

The times and locations of the next PTCOG meetings are as follows:-

PTCOG XXVII	Chiba, Japan	November 17 - 19 1997
PTCOG XXVIII	Loma Linda, CA USA	April 15 - 17 1998
PTCOG XXIX	Heidelberg, Germany	Early October 1998
PTCOG XXX	NAC, Cape Town, South Africa	maybe April 13 - 15 1999

1997 NIRS International Seminar on Heavy Charged Particle Therapy
in conjunction with PTCOG XXVII
Chiba, Japan
November 17 - 19 1997

The meeting of PTCOG XXVII will be held jointly with the 1997 NIRS International Seminar on Heavy Charged Particle Therapy on **Monday November 17 to Wednesday November 19 1997** at NIRS and the Hotel Francs, Chiba, Japan. The meeting is sponsored by JASTRO, Japanese Society for Therapeutic Radiology and Oncology, and will be supported in part by JAIF, Japan Atomic Industrial Forum.

Included separately in this mailing are:-

- REGISTRATION/PRESENTATION form
- HOTEL RESERVATION form

Registration: **Deadline for registration is Sept. 15 1997**. Please return the enclosed registration form as soon as possible with your presentation plan.

Registration Fees: 15,000 Japanese yen; this includes both the conference dinner on Tuesday evening and a reception at HIMAC on Monday evening. The conference dinner fee for an accompanying person is 3,000 yen. The registration must be paid in Japanese yen at the time of registration. No checks or cards can be accepted.

For more information, please contact:

Co-chair K. Kawachi, Ph.D., Director, Acc. Phys. & Eng. Division
Co-chair H. Tsujii, M.D., Director, Radiation Medicine Division,
Secretary J. Mizoe M.D. and E. Takada Ph. D.
Research Center for Charged Particle Therapy
National Institute of Radiological Sciences (NIRS)
4-9-1 Anagawa, Inage-ku, Chiba 263, Japan
E-mail: ptcog27@nirs.go.jp
Fax: +81-43-251-1840 Phone: +81-43-256-0122

Web Page URL: http://nirs.go.jp/PTCOG27

Accommodation: Hotel Francs is offering a special rate for the meeting, effective from Sunday November 16 - Wednesday November 19. The room rate will be 8,000 yen for a single room and 15,000 yen for a twin room including breakfast and taxes etc. **Deadline to reserve a room at the special rate is October 15 1997.**

Tentative Schedule

Day	Time	Site	Events
Sunday Nov. 16	18:00	Francs	Registration and Social Hour
Monday Nov. 17	8:30	Francs	Bus transport to NIRS
	9:00	NIRS	Registration
	9:30 - 13:00	NIRS	Sessions 1,2
	14:00 - 15:00	NIRS	Session 3
	16:00 - 19:00	NIRS	Tour and light supper at HIMAC
	19:00	NIRS	Bus transport to Hotel Francs
Tuesday Nov. 18	8:30	Francs	Registration
	9:00 - 12:30	Francs	Session 4,5
	14:00 - 15:30	Francs	Session 6
	16: 00 - 18:00	Francs	Poster Session
	19:00 -	Francs	Conference Dinner
Wednesday Nov. 19	9:00 - 12:30	Francs	Sessions 7,8
	14:00	Francs	Bus transport to NCC-East Hospital
	15:00 - 17:00	NCC-East	Tours
	17:00	NCC-East	Bus transport to Hotel Francs

The seminar will center around the following focus sessions:

- Conformal particle therapy
- Requirements for a hospital-based facility
- Protocols for clinical trials
- Fractionation of particle beams in biology and medicine
- Dosimetry
- Other topics will also be presented by oral or poster sessions

Presentations: Slide projectors and overhead projectors will be available for the oral presentations. Each poster presentation will be about 0.9 m (~3 ft)wide x 1.5m (~5 ft) high.

Proceedings and Abstracts for PTCOG XXVII

Contributors are invited and strongly encouraged to submit a contribution paper, which will be published (after a due referee process) as a special issue of the journal of the Japanese Society for Therapeutic Radiology and Oncology. The submitted papers are due at the time of registration at PTCOG XXVII. The abstracts of all submitted papers will be published in the January 1998 issue of Particles.

6th Workshop on Heavy Charged Particles in Biology and Medicine
Baveno, Lago Maggiore, Italy
September 10 - 12 1997

The workshop will be organized by ISE of Baveno, Lago Maggiore, on September 10 12 1997, the week before the International Conference on Medical Physics in Nice, France.

It will be dedicated to the presentation and discussion of the new results of experiments and theory in particle radiation biology. The main topic will be the application of charged-particle beams like protons and heavy ions to tumor therapy. In addition, biological, biochemical and physical problems related to radiobiology using beams of heavy charged particles will be discussed.

For further information, please contact:

Roberto Cirio
INFN TO
Via Giuira 1
I - 10125 Torino
Italy
fax; +39 11 6699579

Gerhard Kraft
Biophysics GSI
Planck Str. 1
D - 64291 Darmstadt
Germany
fax: +49 6150 712106

Enzo Sacco
IEO sez. TERA MI
via Ripamonti 435
20141 Milano
Italy
fax: +39 2 57489208

WORLD CONGRESS ON MEDICAL PHYSICS AND BIOMEDICAL ENGINEERING
Nice, France, September 14 - 19 1997

From 14 - 19 September 1997, the **WORLD CONGRESS ON MEDICAL PHYSICS AND BIOMEDICAL ENGINEERING** will take place in Nice on the French Riviera. After Kyoto (1991) and Rio (1994), it will provide an unique opportunity for scientific exchanges and discussions on various topics of interest for all those involved in "Particle therapy".

Jean-Claude ROSENWALD
Co-chair for the Scientific Committee

For information about the meeting:

NICE' 97 - SEE
48, rue de la Procession
F75724 PARIS CEDEX 15, FRANCE
Phone: + 33 1 44 49 60 60
Fax: + 33 1 44 49 60 44

For Scientific contacts on
"protons, neutrons & heavy ions in radiotherapy"

Alejandro MAZAL
Centre de Protontherapie d'Orsay, BP. 65
91402 ORSAY CEDEX, FRANCE
Phone: + 33 1 69 29 87 00
Fax: + 33 1 69 07 55 00

EHTG'97 **Annual Meeting** of the **European Hadron Therapy Group** and the **European Clinical Heavy-Particle Dosimetry Group** combined with the **1st Med-AUSTRON Conference**

Hadrons - A Challenge for High Precision Radiotherapy
Innsbruck, Austria, October 8 - 11 1997

Topics: Tumors of the base of the skull; Prostate cancer; Hadrons vrs. conformal radiotherapy and radiosurgery; Treatment planning for proton and light ion-therapy; Tumor oxygenation and perfusion; Accelerators, beamlines and dose delivery; Gantries for light ions; Active scanning vrs. passive spreading; Social economical aspects of national cancer research centres.

For further information, please contact:

K. Poljanc, Med-AUSTRON, A-2700 Wr. Neustadt, Austria.
e-mail: med-austron@riz.co.at fax: +43 2622 26326 359

PTCOG Information/News/Reports:

The following reports were received by July 1997.

News from **PSI,** Switzerland:

The patient numbers for the 70 MeV proton facility for ocular tumors at PSI at the end of May 1997 are:-

2081 choroidal melanomas
61 recurrences of melanomas
56 choroidal hemangiomas
54 melanomas of the conjunctiva
30 age related macular degenerations
25 intraocular metastases
7 melanomas of the iris
10 miscellaneous ocular tumors

At the end of May 1997, we have treated a total number of 2324 ocular tumors: *Emmanuel Egger, Division of Radiation Medicine, Paul Scherrer Institute, Villigen, CH-5232, Switzerland.*

Ion Beam Interactions with Matter:

A Web site is now available which contains descriptions, manuals, software and installation instructions for various topics in Ion Beam Interactions with Matter. The site is:

http://www.research.ibm.com/ionbeams

(Note: all letters must be lower-case)

This site covers the following subjects:

- **SRIM** : The Stopping and Range of Ions in Matter
  This section contains all the software and manuals of the SRIM program which is widely used for ion stopping powers, ranges and calculations of damage in layered structures.
- **IBA** : Ion Beam Analysis
  This section covers a program to analyze experimental data from Rutherford Backscattering (RBS) and Elastic Recoil Detection (ERD). It covers both ion scattering and target atom recoils for any ion, at any energy, in any layered target. Extensive examples are shown on the Web site illustrating its use.
- **SER** : Soft Error Rate
  This section covers the affects of cosmic rays on terrestrial electronics, and the methods of determining the rate of induced fails. It links to a published article which reviews 15 years of industrial research which untangled the various components of the problem and created a formalism to predict the SER of electronic components.

This Web site is currently being constructed, and the author would appreciate comments from any viewers in order to make it useful and clear. If the download time is too long for any software or manuals, please send a note to the author with a postal address for hardcopy. *James Ziegler, IBM - Research, 28-0, Yorktown, NY 10598.*

News from **Bratislava**, Slovakia:

A project has been approved by the Slovak Government to build a cyclotron at the Cyclotron Laboratory of the Slovak Institute of Metrology, Bratislava. It is expected that the cyclotron will be built and delivered by the Joint Institute of Nuclear Research (JINR) Dubna, Russia, and will have 75 MeV protons and a few MeV/n ions. It is expected that 85% of the beam time will be used for medical applications such as the production of PET isotopes, proton therapy of the eye, and boron-neutron capture therapy. The rest of the beam time will be used for materials research, physics and educational programmes. The scheduled start date is 2000. *Marius Palovic, GSI Darmstadt. Planckstrasse 1, D-64291 Darmstadt, Germany.*

News from the **National Accelerator Centre**, Faure, South Africa and the **Kernfysisch Versneller Instituut**, Groningen, The Netherlands:

PROPOSAL FOR SPOT-SCANNING COLLABORATIVE GROUP

NAC and KVI are presently interested in developing spot scanning systems for proton therapy. Expertise concerning scanned charged particle beams is already available from Berkeley, PSI, Chiba, GSI and Uppsala. Presumably there may be other centres as well as commercial companies which may be interested in spot scanning. It is clear that large laboratories such as NAC and KVI have the necessary expertise and infrastructure to develop spot-scanning systems. However, such systems are complex,

costly and demanding in terms of equipment, manpower and time. Although there will be certain accelerator-specified problems many of the components of spot scanning systems are common. By pooling resources it should be possible to reduce development time and costs, which will be to the long-term benefit of the particle therapy community. We are proposing to establish a working group to jointly develop and test components of spot scanning systems. Although parts of such systems are specific to each centre we would like to consider all aspects related to scanning. These include scanning magnets, power supplies, control philosophy, position monitors, dosimetry, treatment planning and quality assurance. Hopefully people from those centres who have already developed scanning systems will also be interested in participating since we can learn from their experiences. Those who would consider joining such a group please send your names (and any suggestions) to one of the undersigned before 30 September 1997. Once we have determined the extent of interest in the proposal we will make suggestions regarding the infrastructure and operation of the group. *Dan Jones, National Accelerator Centre, P O Box 72, Faure, 7131 SOUTH AFRICA.*
Tel: +27-21-843-3820; Fax: +27-21-843-3382; e-mail: jones@nac.ac.za.
Marco Schippers, Kernfysisch Versneller Instituut, Zernikelaan 25, 9747 AA Groningen, THE NETHERLANDS. Tel: +31-50-363-3600; Fax: +31-50-363-4003; e-mail: schippers@kvi.nl

News from **Indiana University,** Indiana, USA:

Proton therapy treatments are scheduled to resume this fall at the Indiana University Cyclotron Facility. A fixed horizontal beam line has been reconfigured for eye treatments. The initial treatments will be a clinical trial on choroidal neovascular membrane in age-related macular degeneration. This study is led by Thomas A. Ciulla, M.D. (IU Department of Ophthalmology). Others participating in this study include Newell Pugh, M.D. (Department of Radiation Oncology, IU-Methodist Hospital) as well as several faculty from the IU School of Optometry.

In the longer term, IU is trying to raise $15M to convert existing beam lines to a dedicated radiation therapy center. This facility would be operated as a regional center (the Midwest Proton Radiation Institute), involving personnel from medical facilities in Indiana and neighboring states. IU recently advertised a new position for the medical director of this planned center. *Chuck Bloch, Indiana University Cyclotron Facility, 2401 Milo B. Sampson Lane, Bloomington, IN 47408-0768*.

News of Heavy-ion Therapy at **GSI**, Darmstadt, Germany:

There is a German saying: The devil hides in the details.

After having completed the set up of the medical treatment area and control and safety system, the period of systematic and long-term testing started this spring. For the intensity-controlled rasterscan system the energy range of interest between 80 MeV/u and 430 MeV/u is divided into 255 energy steps, from which approximately 30 are used for an individual treatment. These energies can be delivered in 7 steps of different foci between 4 and 10 mm and 15 intensity steps between 2×10^6 to 2×10^8 particles per second. This switching of parameters from pulse to pulse i.e. within 5 sec. has been put into routine operation. The time sharing between physics experiments and therapy, where therapy interrupts these physics experiments and switches to the carbon beam for the irradiation, went smoothly. Switching times of 10 to 20 sec. could be achieved, including some preparatory carbon cycles of the synchrotron, before the beam was delivered to the medical area.

The beam monitoring system consisting of two multi-wire proportional counters and three parallel plate ionisation chambers are now routinely used in order to sample the center of gravity of the beam spot at a rate of 6 kHz and the intensity at 80 kHz. The spatial stability as well as the intensity fluctuation of

the delivered beam spot are acceptable for the planned application. However, the spatial stability in a 100 μsec interval differs from the average over longer times that are relevant for irradiation. Therefore, greater deviations in the microstability can be allowed compared to the macrostability.

The PET-camera has been used in order to verify treatment planning in various phantoms including an Alderson phantom and produces outstanding results. The measurements for the governmental approval have been completed in the last beam times. The minutes of these tests will be submitted to the reviewers and we hope to obtain the approval before the end of the year. *Gerhard Kraft, GSI mbH, Planckstrasse 1, D-64291 Darmstadt, Germany.*

A Progress Report for the Proton Treatment Facility at **NCC, Kashiwa**, Japan:
(abstract of PTCOG XXVI poster presentation)

The project of proton treatment facility at the National Cancer Center Hospital East (NCC, Kashiwa), JAPAN, is proceeding on schedule. The prime contractor of the building was Tokyu Construction Co.. Building construction started in May, 1996, and completed at the end of March, 1997. The prime contractor of the equipment is Sumitomo Heavy Industries Ltd.. Equipment manufacturing has proceeded very well, and the most of them has already been installed into the building. This facility is primarily medically dedicated. Therefore, the building is connected with the hospital building through passageway.

235 MeV isochronous cyclotron, which is the same as that of NPTC was installed. Energy selection system (ESS) reduces the 235 MeV beam extracted from the accelerator to 190, 150 and 110 MeV. There are two isocentrically rotating gantry treatment rooms. Manufactured parts of a gantry are assembled and a test run was performed at the works. Accuracy of isocenter (+/-1 mm), accuracy of stop angle(+/-0.5 degree), rotational speed(1 rpm), etc. were confirmed. Assembled gantries were decomposed at the works, and re-assembled at the hospital. Caterpillar-driven relatively rotational floor (caterpillar tread), which enables us to access to a patient at arbitrary gantry angle, was originally developed. Patient enclosure of the gantry, part of fixed horizontal beam delivery system, patient positioning system, CT & simulator, MRI, bolus and collimator fabrication machines were already installed into the building.

Accurate setting and adjustment of each equipment is now on going. For the gantries, test run is being carried out. The software for control, safety, network and treatment planning are now under development. We are expecting to start, testing the extracted beam in the autumn of 1997, and treating patients in the latter half of 1998.

In Japan, incidence of eye melanoma, chordoma and skull base sarcoma is quite low. In contrast, that of lung cancer and liver cancer is increasing. For liver cancer (hepatocellular carcinoma), encouraging results by proton therapy are reported from Proton Medical Research Center (PMRC) of Tsukuba, Japan. For lung cancer, we are conducting a trial of mass-screening to find out early lung cancer patients using helical scanning CT. Its' preliminary results revealed that a lot of candidates for proton therapy were found, and some part of them had no lymph node metastasis by operation. One of the distinguished characteristics of our hospital is quite large number of head and neck cancer patients is being treated. Therefore, we are planning to do, for a start, dose escalating phase I/II clinical trial for cancer of the liver, lung and head & neck.

Fig. 1 cyclotron and part of beam transport line

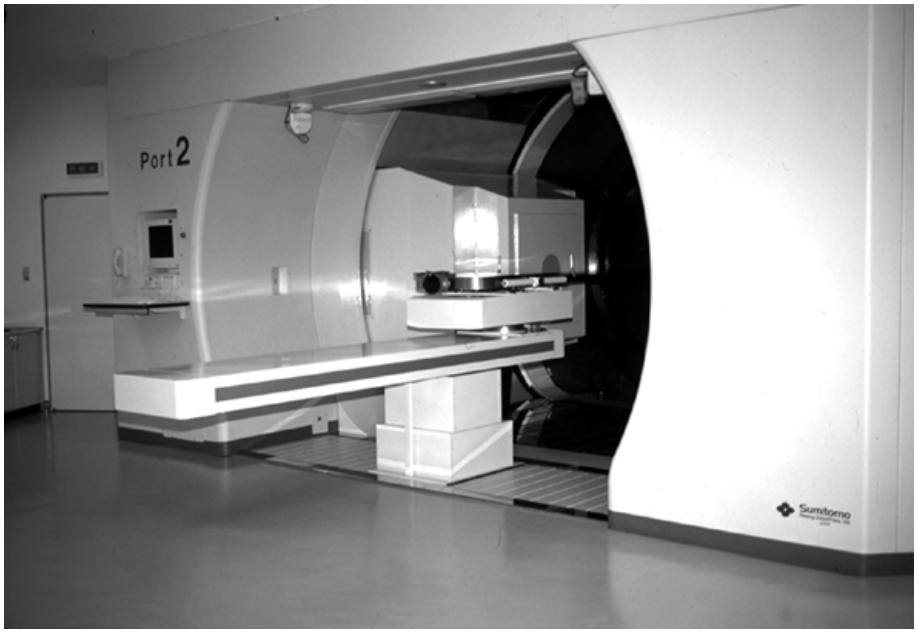

Fig. 2 Gantry treatment room

T. Ogino, S. Murayama, N. Moriyama, H. Ikeda, S. Yoshida and S. Ebihara, National Cancer Center Hospital East, Kashiwa, Japan.

Book Review: "People and Particles" by Cornelius and Ida Tobias

Cornelius A. Tobias and his wife Ida have published a very interesting book chronicling from the early days of the Ernest Lawrence's cyclotron to the heavy ion research at the Bevalac. It is not a technical book, but is written as if the historic events unfold. Tobias says that he wrote the book to explain to his granddaughter what he did.

Tobias, who retired after forty years as professor of biophysics at University of California Berkeley and the heavy ion research group leader at the Lawrence Berkeley National Laboratory (LBNL), is a pioneer in the physical studies of the biological effects of ionizing radiation, including those of cosmic rays. He is past president of the Radiation Research Society and was a member of the founding council of the Biophysics Society.

The book describes the Lawrence Brothers and their laboratories (the Crocker and Donner Laboratories and LBNL), which were principally responsible for the advent of radioactive tracers in study of living organisms. Using the natural radioisotopes George Hevesy originally discovered the radioactive tracer method, but the detailed biological applications of tracers had to wait the discovery of vast array of radio-isotopes at Ernest Lawrence's cyclotron. In 1934 his brother John Lawrence compared for the first time the biological effectiveness of neutron rays to those of x rays and began therapeutic investigations including successful treatment of polycythemia vera. Soon an avalanche of biological studies was under way at Berkeley. Initially, radioactive inert gases as well as radio-sodium and radio-phosphorus were used in biological research, and studies of radio-iodine, radio-iron, and radio-strontium were added. The Rockefeller Foundation made it possible to build the first medical cyclotron.

William Donner donated funds for the Donner Laboratory, dedicated to the applications of physical sciences to biology and medicine. The Donner Laboratory, with help from Hardin Jones, became engaged in research on decompression sickness during WWII; and early staff member, Joseph Hamilton, was working on the biological effects of fissionable elements, as well as doing research on uranium and plutonium. After the war, the Laboratory became a training center for the new radiation sciences.

In the early postwar years Donner Laboratory made basic contributions to hemodynamics. In 1947 a dose of short-lived radioactive carbon was applied to human being for the first time. Hal Anger built the first gamma-ray camera that could visualize the distribution of gamma-ray emitting isotopes in the body. Another instrument of the day was the "Monster" capable of measuring the various rate of uptake of isotopes.

In addition to applying fast neutrons to cancer therapy by Robert Stone, Bob Wilson proposed the use of high-energy protons and heavier ions in treatment of cancer. 1n 1947 it was also shown that heavier ions had potential uses in therapy because of their ability to reduce the radiobiological "oxygen effect." The application of protons and helium ions was successful in early treatment of acromegaly and Cushing's disease.

Studies of the biological effects of accelerated heavy ions began at Berkeley in 1954 with the discovery that heavy particles exerted their biological effect by producing double-strand scission in DNA, whereas x rays produced predominantly only single-strand breaks. This finding led to detailed studies of biological effect of heavy ions, and to the acceleration of higher-Z heavy ions to high energies in the Bevalac.

It has been shown since 1949 that high-energy heavy ions are continually impinging on the earth from space. Astronauts who have flown in space have reported seeing "streaks, stars, commas, and luminous clouds." Experiments with heavy ions generated at the Bevalac have confirmed that these sensations result when individual heavy ions cross the human retina.

The readers are rewarded at the end of the book with three bonus chapters, in which Tobias, with help of several illustrious scientists, discusses the nature and progression of time. Living systems are their own

time clocks and the actions of living organisms, such as learning and memory, depend crucially on the passage of time.

Cornelius Tobias and his wife Ida have done a fine literary job of telling the scientific story, intertwined with the many colorful personalities; they lived through this period and were able to add many personal vignettes to the scientific discoveries. Both the layman and the scientist will enjoy this highly personal account of "People and Particles."

The book is published by the San Francisco Press, and is available at the following bookstores in Berkeley: Cody's Books, 2454 Telegraph (at Haste); or Black Oak Books, 1491 Shattuck (in North Berkeley, next to the Saul's)

Copies may be ordered by sending a check for $25 plus $2 for handling and postage (CA resident add state tax) to the following address. All orders must be prepaid; sorry no credit card orders.

San Francisco Press
P.O. Box 426800
San Francisco, CA 94142-6800
(tel. 510 524 1000)

Get your copy and enjoy it. *Bill Chu, 71-259, Lawrence Berkeley National Laboratory, Berkeley, CA 94720.*

Proposed NEW FACILITIES for PROTON & ION BEAM THERAPY
July 1997

INSTITUTION	PLACE	TYPE	1ST RX?	COMMENTS
Berlin	Germany	p	1997	72 MeV cyclotron; eye treatment beam line.
G.S.I Darmstadt	Germany	ion	1997	First Carbon beam in the medical cave 7/6/95
KVI Groningen	The Netherlands	p	1998	plan:- 200 MeV accel.; 2 rms; 1 gantry; 1 fix.
NPTC (Harvard)	MA U.S.A.	p	1998	at MGH; 235 MeV cyclotron; 2 gantries + 3 horiz.
Kashiwa	Japan	p	1998	235MeV cyclotron;2gantries;1horiz; under construction
INFN-LNS, Catania	Italy	p	1999	70 MeV; 1 room, fixed horiz. beam
Bratislavia	Slovakia	p, ion	2000	75 MeV cyclotron; p; ions; +BNCT, isot prod.
Hyogo	Japan	ion	2000	protons & ion; 2 gantries; 1 horiz; 1 vert; 1 45 deg.
Tsukuba	Japan	p	2000	2 treatt rooms with gantries; 1 'developmental' room
TERA	Italy	p, ion	2002?	H- accel; 60-250 MeV p; +BNCT; isotope prod.
AUSTRON	Austria	ion	?	protons and light ions.
Beijing	China	p	?	250 MeV synchrotron.
Central Italy	Italy	p	?	cyclotron; 1 gantry; 1 fixed
Clatterbridge	England	p	?	upgrade using booster linear accelerator.
ISS (Italian "NIH")	Italy	p	?	200 MeV linac;1eye room; gantry?;under construction
ITEP Moscow	Russia	p	?	3 horiz.-1 fix beam, 2 gantry, 1 exp., H- accel.
Jülich (KFA)	Germany	p	?	exp. beam line; plans for therapy.
Krakow	Poland	p	?	60 MeV proton beam.
Kyoto	Japan	p	?	250 MeV synchrotron; gantry; 1 fixed horiz beam.
Moscow	Russia	p	?	320 MeV; compact, probably no gantry
NC Star	NC U.S.A.	p	?	synchrotron; 70-300 MeV; 2 horiz; 1 gantry
Proton Development N.A. Inc.	IL USA	p	?	300 MeV protons; therapy & lithography
PROTOX	England	p	2001?	existing RAL synchrotron; 250 MeV; 3 treat. gantry

WORLD WIDE CHARGED PARTICLE PATIENT TOTALS

January 1997

WHO	WHERE	WHAT	DATE FIRST RX	DATE LAST RX	RECENT PATIENT TOTAL	DATE OF TOTAL
Berkeley 184	CA. U.S.A.	p	1954	— 1957	30	
Berkeley	CA. U.S.A.	He	1957	— 1992	2054	June-91
Uppsala	Sweden	p	1957	— 1976	73	
Harvard	MA. U.S.A.	p	1961		7181	June-97
Dubna	Russia	p	1967	— 1974	84	
Moscow	Russia	p	1969		2838	May-96
Los Alamos	NM. U.S.A.	π-	1974	— 1982	230	
St. Petersburg	Russia	p	1975		969	Dec-95
Berkeley	CA. U.S.A.	heavy ion	1975	— 1992	433	June-91
Chiba	Japan	p	1979		96	Oct-96
TRIUMF	Canada	π-	1979	— 1994	367	Dec-93
PSI (SIN)	Switzerland	π-	1980	— 1993	503	
PMRC, Tsukuba	Japan	p	1983		525	Mar-97
PSI (72 MeV)	Switzerland	p	1984		2324	May-97
Dubna	Russia	p	1987		40	Nov-96
Uppsala	Sweden	p	1989		112	Apr-97
Clatterbridge	England	p	1989		764	July-97
Loma Linda	CA. U.S.A	p	1990		2324	June-97
Louvain-la-Neuve	Belgium	p	1991		21	Nov-93
Nice	France	p	1991		636	Nov-95
Orsay	France	p	1991		956	May-97
N.A.C.	South Africa	p	1993		191	Mar-97
IUCF	IN USA	p	1993		1	Dec-94
UCSF - CNL	CA U.S.A	p	1994		120	June-97
HIMAC, Chiba	Japan	heavy ion	1994		150	Aug-96
TRIUMF	Canada	p	1995		23	Dec-96
PSI (200 MeV)	Switzerland	p	1996		1	Dec-96
					1100	pions
					2637	ions
					19309	protons
				TOTAL	23046	all particles

See Page13.
for
The Proposed New Facilities Table