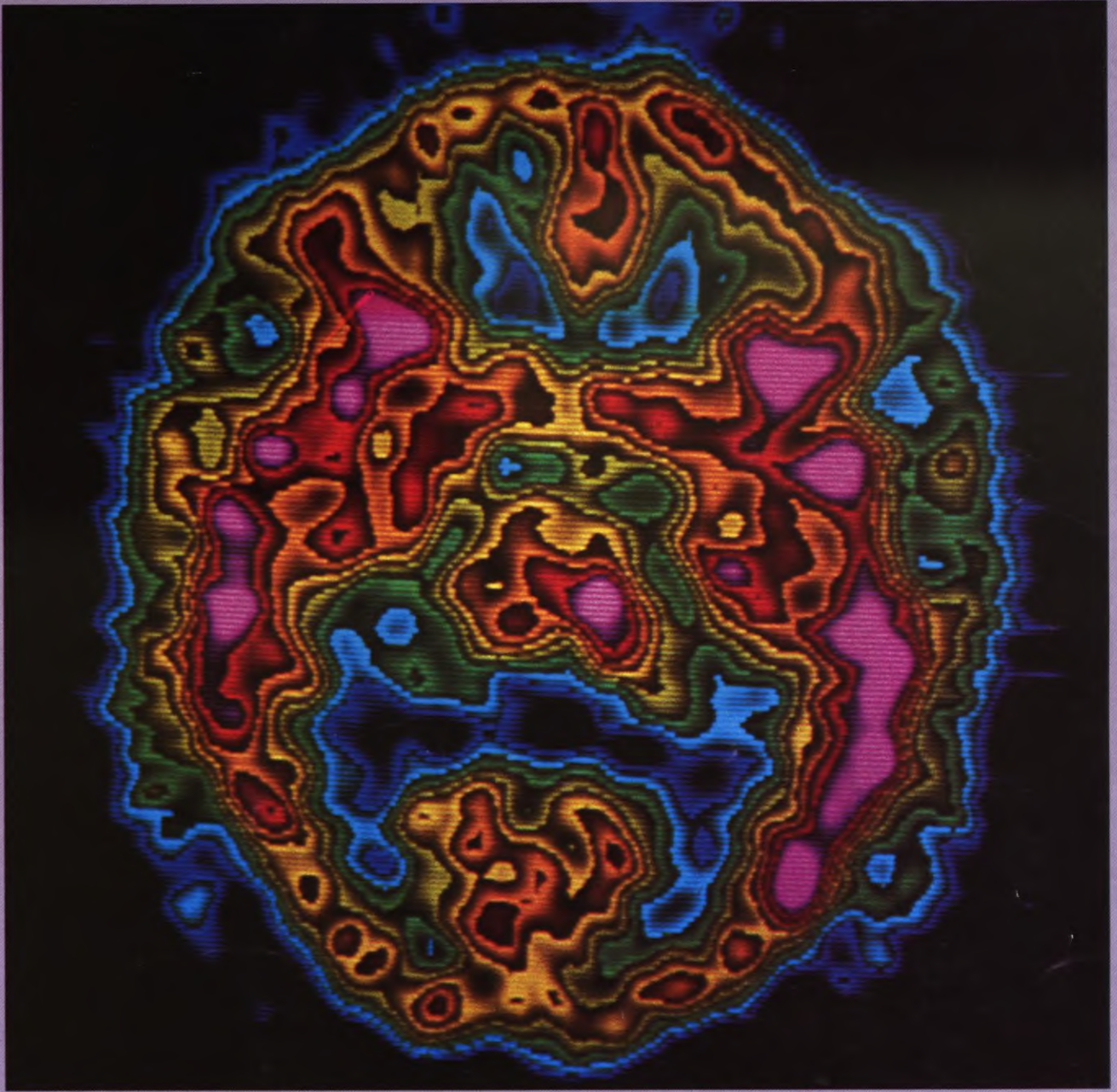


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MEDICAL TECHNOLOGY: THE CANADIAN EXPERIENCE



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Radioisotopes are packed for shipment.

Cover photo:
An image of the distribution of blood flow in the human brain taken in cross-section by a nuclear medicine camera at McMaster University Medical Centre (London, Ontario).

Dept. of External Affairs
External Information Services Division
Communications and Culture Branch
Ottawa, Ontario K1A 0G2
Canada

The purpose of this series is to inform readers of current trends in Canadian technology.

General Publications Section,
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Ottawa, Ontario K1A 0G2
Canada.

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Published by Authority of the
Right Honourable Joe Clark,
Secretary of State for External Affairs,
Government of Canada, 1986.



Introduction

When you live in the shadow of one of the most powerful, innovative nations on earth, the United States, you can't sit still for long. If you do, you will be frozen out of existence – literally.

Canadians, for this and countless other reasons, have long since learned the importance of innovation – thinking for themselves. Stemming from a fundamental principle of maintaining a unique identity, this determination has manifested itself in achievements in numerous fields, ranging from communications and satellite advances to medical technology.

In the 64 years since the discovery of life-saving insulin by Canadians Frederick Banting and Charles Best, medical researchers have increasingly moved

Canada into the forefront of new frontiers of medicine.

From pioneer breakthroughs in specialty areas like heart surgery, artificial prosthetic devices and heart pacemakers, to an intimate understanding of some of the complexities of the brain, researchers have opened new vistas encompassing everything from immunology and organ transplants to blood vessel surgery in some of the almost inaccessible areas of the human brain.

In today's "high tech" era, Canadian researchers and clinicians are researching and developing some of the most sophisticated medical diagnostic and treatment hardware. The list of products ranges from abdominal surgical

belts to the latest linear accelerator cancer treatment machines. And in between are to be found everything from yoke assemblies for medical gases to implantable heart pacemakers.

Because of its enormous size – Canada comprises some 10 million square kilometres – and its small population of 25.5 million scattered over the broad expanse, this nation has also pioneered the development of medical technologies operable in both metropolitan and remote, sparsely populated outposts. Where it is not feasible to bring all the medical tools to an isolated settlement, researchers have developed advanced communication networks employing satellite "telehealth" to "deliver" the capabilities of these devices where they are needed.

In numerous health science centres in major cities across Canada, researchers have been, and are developing, new medical diagnostic and treatment modalities. And innovative design experts in private industry are fabricating a growing number of diagnostic and therapeutic devices for inclusion in medical tool chests everywhere.

This country's international reputation for medical expertise, coupled with its technological know-how in developing high quality, precision medical devices, are creating increasing demands for our products abroad.



The Therasim 130, which simulates radiotherapy treatment.

Canadian Medical Devices

Canada is recognized as having one of the finest and most all-encompassing health care delivery systems in the world – a system operating with some of the best and most sophisticated medical tools in existence. Its relatively small population spread from the Atlantic to the Pacific oceans and from the United States border to the high Arctic tundra, is served by a national medicare system that guarantees affordable health services to everyone.

Financed through several sources including health insurance premiums and general taxation, national medicare, which was fully implemented in Canada in 1961, rapidly became an organized health care delivery network to meet both large urban demands as well as those in more sparsely populated regions.

With the emergence of this health care umbrella to protect its citizens from the financially-devastating effects of uninsured serious health problems, use of the serv-

ices skyrocketed. No longer did patients have to shy away from physicians, clinics and hospitals for fear of receiving high bills.

This dramatic change led to the construction of large, fully-equipped hospitals and clinics, fitted with the latest in technology and operated by skilled personnel. In addition, major emphasis was placed on medical research, supported by governments in Canada, the USA and elsewhere, as well as by private industry and philanthropy.

Canada, which for a long time had imported most of its health care products and other medical devices, began a concentrated expansion of its own manufacturing industry.

Health and Welfare Canada, the federal government body responsible for administering and policing the Food and Drugs Act, has defined medical devices as any article, instrument, apparatus or contrivance, including any component, part or accessory thereof, manufactured, sold or represented for use in:

the diagnosis, treatment, mitigation or prevention of a disease, disorder or abnormal physical state, or the symptoms thereof, in man or animal;

restoring, correcting or modifying a body function or the body structure of man or animal;

the diagnosis of pregnancy in humans or animals;

the care of humans or animals during pregnancy and at and after birth of the offspring, including care of the offspring.

Contraceptive devices are included but not drugs.

Today, more than 400 Canadian firms across the nation manufacture and supply more than 1 200 different medical products for both the domestic and export market. Their lines comprise a range of accessories, chemical agents, instruments and other items required for hospitals, doctors offices, clinics and other health care facilities. They include:

diagnostic instrumentation and "in vitro" laboratory testing products;

diagnostic, therapeutic and monitoring equipment and accessories;

implants such as pacemakers; prosthetic devices and sensory aids;

hospital, medical and surgical instruments;

equipment and accessories ranging from adhesive bandages to sutures, diagnostic and treatment radiation equipment and supplies;

surgical supplies;

sterile and disposable devices;

dental equipment, instruments and supplies.

A number of companies also produce aids for the handicapped, ranging from limb braces and joints to wheelchairs, stretchers and beds.



The Theraplan L, which is used for planning radiotherapy cancer treatment.

Cancer Therapy

Unit and Cobalt-60

Sources

On an October morning in 1951, the world's first commercial cobalt-60 therapy unit in London, Ontario, Canada was used to treat a cancer patient.

That epochal event, coming just six years after the formation of the fledgling commercial products division of Eldorado Mining and Refining Ltd., marked the beginning of Canada's growth to the status of a world leader in the use of nuclear technology in the medical field.

Today, Atomic Energy of Canada Limited (AECL), a federal Crown corporation, is a major producer of radioisotopes, cancer therapy units and irradiation facilities.

In a cobalt-60 unit, gamma rays emitted from a cobalt-60 source are directed at a tumor. A single such source is capable of providing 31 500 treatments to 1 500 patients over five years.

Continual modifications and improvement on that first cobalt-60 therapy unit have been made over the past three decades.

Annually, over 500 000 patients in 80 countries undergo treatment on one of a range of AECL cancer therapy units of which over 1 700 are in operation around the globe.

The Phoenix, the latest addition to AECL's cobalt-60 therapy program, has the advantage of low initial cost and it is able to integrate with the latest treatment techniques and systems. This machine, with its high quality beam and dose distribution, is easily installed for quick operation. Further, it requires no daily run-up and calibration as do some units. It offers special benefits for therapy in the head and neck region.

AECL maintains a special beam therapy source measurement cell

that enables measurement of radiation source output with less than one degree of beam scatter.

When it was first incorporated in 1952, AECL was handed responsibility for nuclear research in Canada – all of it for peaceful purposes; research that in its industrial application resulted in the development of CANDU, one of the most successful nuclear reactor electrical generating systems on earth.

Cobalt-60, a radioactive isotope produced in the CANDU reactors by the irradiation of cobalt-59, is in ever-increasing demand in a world learning the potential of gamma ray technology.

The Theratron 780-C is the world's most advanced such unit. It is designed and built to provide clinic cost effectiveness and is fully compatible with existing treatment methods. New design features, drawn from studies of other Theratron operations in over 1 000 clinics throughout the world include a 35-centimetre "rotation axis to collimator distance" – the greatest possible clearance for any such unit and a precise 0 degree lock on the source head swivel. And there are many more.

Since launching its cobalt-60 program, AECL has encapsulated more than 100 million curies; its annual production rate has reached 20 million, making it the world's major supplier of radioactive cobalt.

AECL uses only high specific activity pellets, thereby making it possible to produce small diameter (0.5 to 2 cm) sources with radiation outputs much larger than some other sources containing low activity cobalt. Also, the sources are doubly encapsulated and the use of nickel plated pellets prevents dusting and corrosion.



The Theratron 780C, the most advanced cobalt-60 cancer treatment machine in the world.

Today, AECL provides over half the world's supply of radioactive isotopes for medical diagnostic procedures.

Treatment Planning

The fact that one spoonful of medicine may be good for what ails you does not always mean two are better. The second may actually be harmful.

In radiation therapy for cancer the rules are no different, the objective being to determine how much and where the radiation is needed and then to make sure the prescription is accurately filled.

That is where Atomic Energy of Canada's medical division, AECL

Medical, comes in with treatment "simulators", which make it possible for the therapy team to, in effect, "practise" a treatment protocol before exposing patients to gamma rays.

With the use of a device known as Therasim 130 and a treatment planning system dubbed TP-11L or Theraplan L, both designed and manufactured by AECL, all data on the size and location of a tumor is put into a computer. There, the correct radiation dosage is calculated.

Theraplan L permits three-dimensional "density" data obtained from computerized axial tomography (CAT) scans to be used in calculating dose distributions for

different areas of a tumor.

The system's console includes a colour monitor to display CAT scans and graphics, as well as an alphanumeric terminal, standard keyboard, numeric keypad and a trackball and potentiometers cluster for interaction with the CAT pictures. The system will work with most types of CAT scanners.

The use of electron beams in radiation therapy is growing steadily today and both the TP-11L and Theraplan L systems give beam calculations for all electron energy levels both for fixed and moving therapy fields.

Another aid in following the patient's treatment is AECL's "TRIM" tumor registry where patient records of diagnosis and treatment can be stored. This system makes possible instant recall of information for hospital statistical purposes as well.

To meet the need for qualified operators, AECL provides training courses on its computer-based system at its plant near Ottawa. It also maintains service centres and parts depots in the USA, Australia as well as in other parts of Canada.

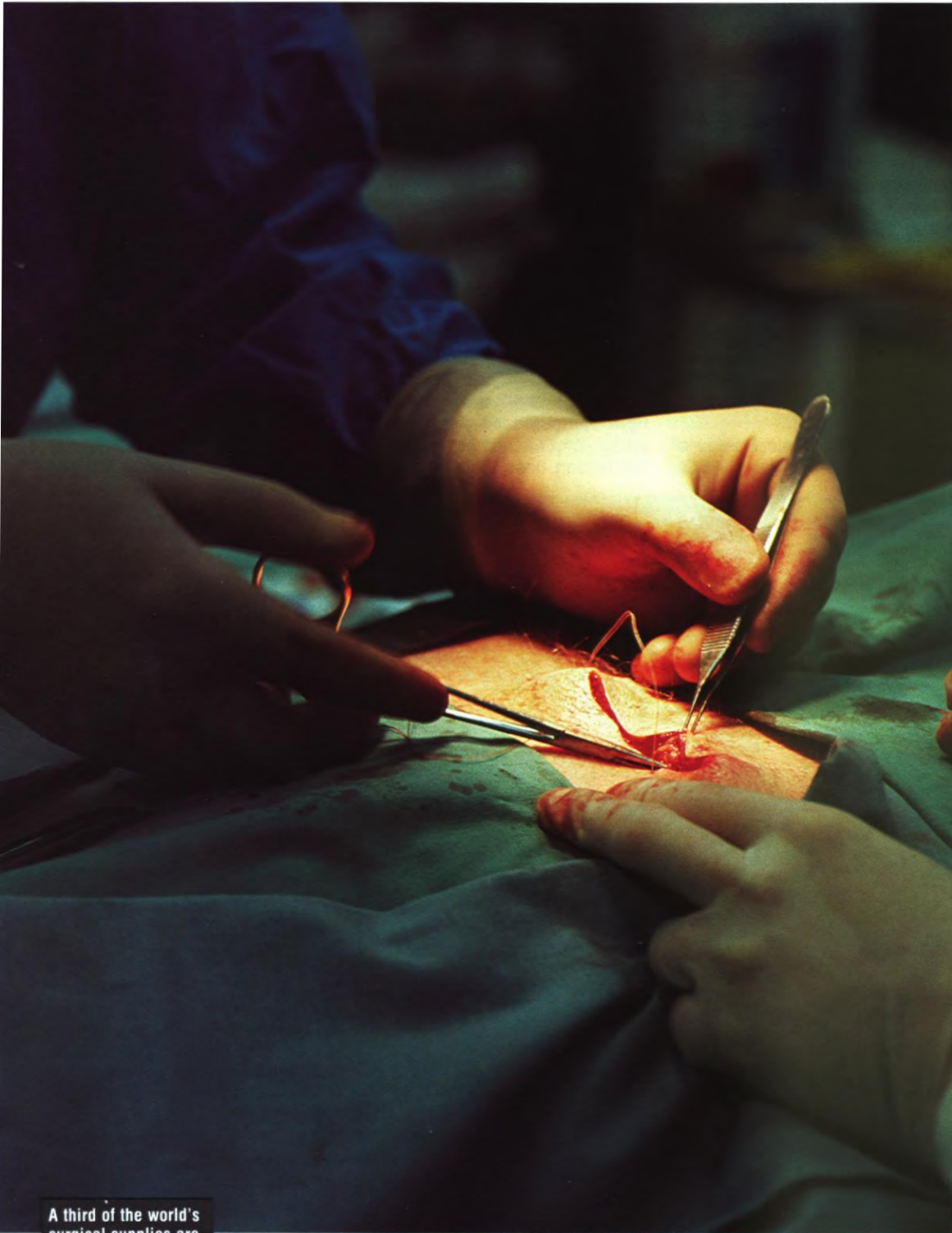
Nuclear Medicine

Over half the world's supply of medical radioactive isotopes is supplied by AECL. Its industrial and isotope products division, is a major supplier of radioisotopes.

One of several isotopes can be attached to a drug designed to concentrate on a particular internal organ doctors may wish to examine. It collects there after injection into the bloodstream and a gamma camera or nuclear medicine camera then obtains an image of the organ.




The latest addition to AECL's cobalt-60 cancer treatment program is the low costing Phoenix.



A third of the world's surgical supplies are sterilized with gamma ray sterilizers.

Among isotopes produced by AECL are technetium-99m, for examining functioning organs, xenon-133 for lung scans, iodine-133 for viewing the thyroid gland and gallium-67, which is capable of spotting hidden abscesses or detecting soft-tissue tumors like Hodgkin's Disease. Images of heart function during rest and exercise stress testing can be obtained with thallium-201.

AECL, in co-operation with the renowned Montreal Neurological Institute, has developed a "mind-reading" machine. The device, known as Therascan 3128, permits doctors to look inside the brain to study body chemistry and organ function. Therascan 3128, which uses a radioactive tracer to spot abnormalities before they can be seen on X-ray, holds promise of major advances in the study and diagnosis of strokes and epilepsy. In addition, it is capable of detecting certain patterns associated with mental disorders like schizophrenia and manic depression.



Cobalt-60 radio-
isotope "pencils".
These are loaded into
licenced shielded
containers for ship-
ment abroad.



One of a series of Gammacell irradiators produced by AECL. This model is the Gammacell 220, the most popular general purpose research irradiator in the world.

Gamma Sterilizers

Control of disease-spreading bacteria and viruses is critical in health care, especially in hospital environments where thousands of tonnes of disposable medical supplies require sterilization.

A full third of all such surgical supplies in the world are now being sterilized with gamma radiation from cobalt-60. Not only is Canada the major supplier of this radioactive source, it is also a manufacturer and exporter of industrial irradiators precisely for this purpose. More than 70 large scale Canadian-made irradiators are now in use in a number of countries for sterilization of medical supplies. A Japanese customer has the largest of AECL's sterilizers. The unit has a total processing capacity of 200 000 cubic metres of supplies a year.

AECL also produces the Gammacell 220 research irradiator, of which over 200 are in operation in laboratories abroad. They are used in many areas of study in medical product sterilization, biological and genetic effects, food preservation, chemistry, pollution, growth stimulation, male sterilization techniques for insect control and irradiation of semi-conductors.

One of the uses of AECL's Gammacell 1000 irradiator is to destroy antibodies in donor blood prior to transfusing it into patients suffering from immunological deficiency diseases.

Stress Testing

Stress, whether we like it or not, is an inescapable part of our lives.

As the late Dr. Hans Selye, the internationally acknowledged Canadian expert on stress said: "any situation in life that puts demands upon our adaptive mechanisms creates stress".

Stress may result from tension at home, at work or at play. Psychologically, "distressing" occurrences such as frustration, failure and humiliation are among the most stressful events we experience. However, success on the job or victory on the playing field also produce stress, albeit of a more pleasurable nature. In fact, without the physiological effects produced by stress, we might not succeed. Stress can be a source of energy and strong motivation to succeed.

It is how we cope with stress – the way we master it and make it work for us before it takes control – and how we adapt to its presence, that is infinitely more important than the fact that we have it. In reality, stress, when properly handled, is the spice of life.

The fact is, countless millions of human beings suffer from undue stress and, more importantly, mishandled stress. For them, stress has become the master and they the servant. As such, over time, they face very real health risks. Stress overload is now considered to be a major cause of illness, both physical and mental.

Physical fitness, through recreation activities such as jogging, swimming, cycling and the like, has become a major commitment for thousands of people. We are, in fact, in the midst of an unprecedented era of personal physical fitness training, fuelled by growing and irrefutable medical proof of its value in improving and maintaining good health.

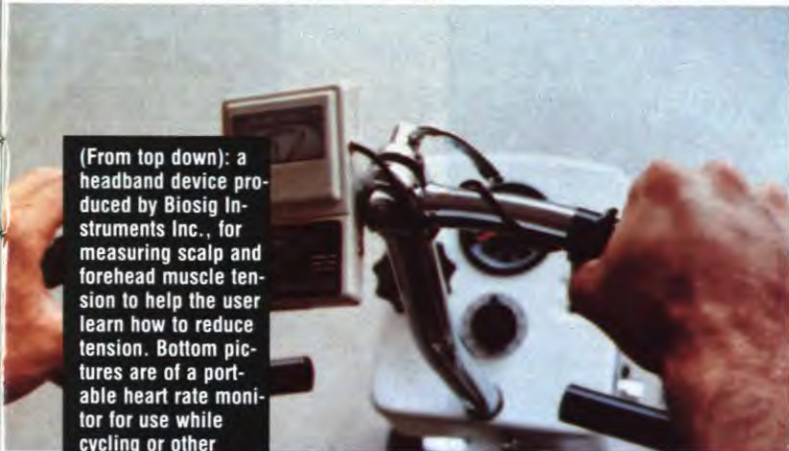
Not only is such activity good for the general improvement and upkeep of the body through improved cardiovascular and respiratory performance, as well as muscle conditioning and weight control, it has the added benefit of helping to burn off pent-up stress, so common among people spending their working hours in sedentary desk jobs.

Fitness buffs are not only keen on knowing how their body systems are improving as a result of exercise but many are determined, for their own curiosity, satisfaction and safety to have visual proof of how they are standing up to, and improving physically from such activity.

Then there are very valid reasons – health and safety reasons – for determining a person's fitness level and how much exercise he or she can stand before embarking on strenuous activity such as jogging. In fact, everyone over the age of 35 should have a full medical and exercise stress test before beginning such activity, especially if it is a new venture.

Biosig Instruments Inc. of Montreal, Quebec, produces a full line of biomedical devices for heart-rate monitoring during exercise.

One such aid is a hand-held heart rate monitor for use on bicycles, treadmills or other cardiovascular equipment. The device, which does not require the use of electrodes attached to the body, weighs only three ounces and monitors the electrical signals that cause the heart to contract. It also displays the time interval between each beat, making it possible for the user to maintain the heart rate at the effective "training" level and to monitor the recovery rate to normal resting pulse after completing an exercise workout. It is produced in several models for different exercise situations.



(From top down): a headband device produced by Biosig Instruments Inc., for measuring scalp and forehead muscle tension to help the user learn how to reduce tension. Bottom pictures are of a portable heart rate monitor for use while cycling or other forms of exercise.

The firm has also developed a new radio telemetry heart rate monitor which operates in conjunction with a tiny radio transmitter and hand-held receiver capable of interference-free monitoring within about ten metres.

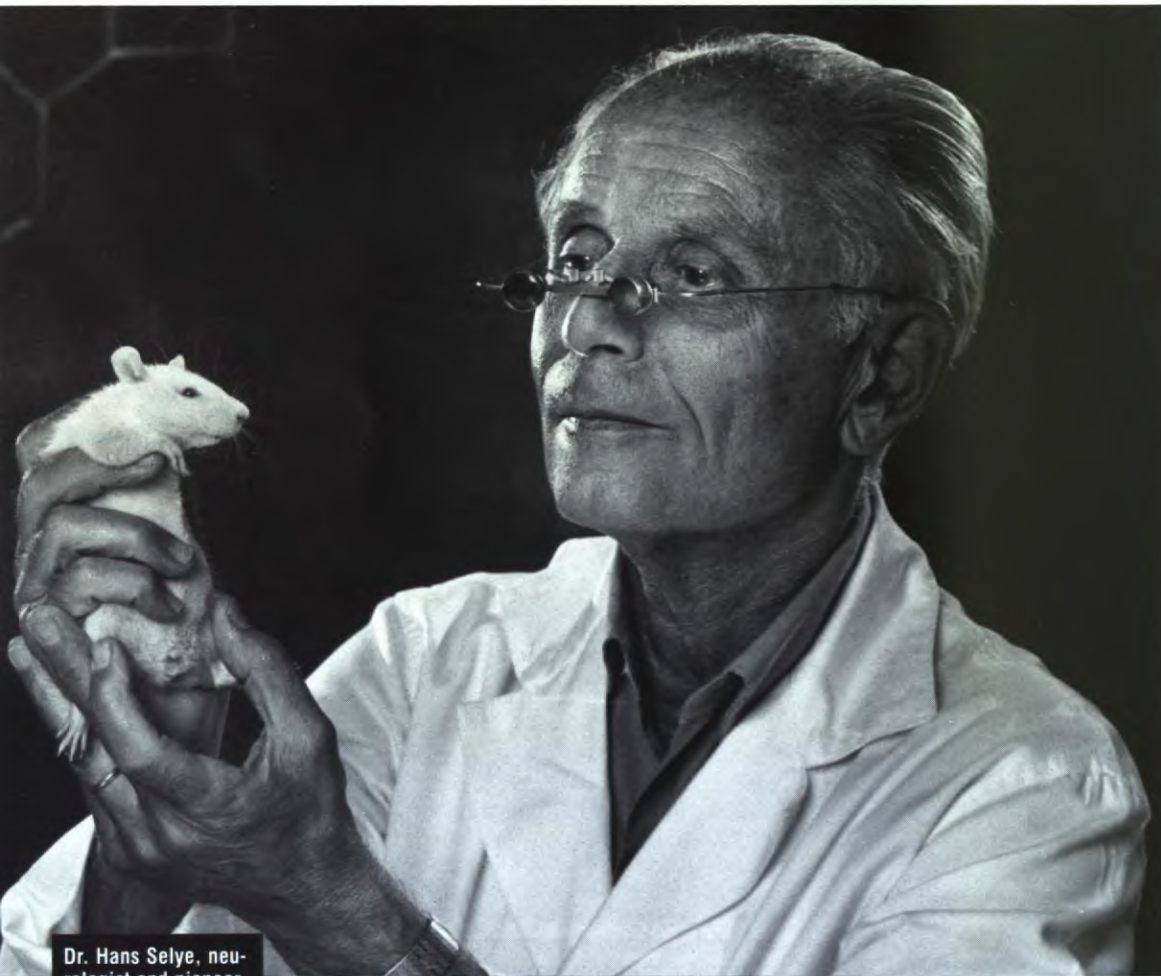
Another of its products, an "electronic gym", measures the electrical activity of various muscle groups during isometric exercise. This is achieved by applying a sensor pad over a particular muscle group where the individual can learn how to exercise these muscles in the most effective manner before moving on to a more rigorous level.

Muscle tension and soreness, a common symptom of unreleased, pent-up stress, can be monitored with another Biosig Instruments product, a biofeedback device. The light-weight, portable unit, worn around the head, measures electromyographic (EMG) activity from the "frontalis" or forehead and scalp muscles. It converts the EMG signal into a pleasant, audible tone proportional to the amount of tension monitored from the muscles. By listening to the tone, the individual develops an awareness of when these muscles are under tension and, over time, how to better relax them and relieve tension. An associ-

ated type of biofeedback device is valuable for relieving headache-causing muscle tension.

Biofeedback systems, designed to help a patient, possibly with headaches due to stress, are in ever-increasing use today. By demonstrating to the individual the types of situation or circumstances under which the stress occurs and the subsequent symptoms, an expert can help the individual "learn" ways to avoid undue tension and thereby avoid those symptoms.

The system measures various changing body conditions such as temperature, blood pressure, heart rate and perspiration, all internal body responses to varying conditions of stress.



Dr. Hans Selye, neurologist and pioneer in the field of stress studies. (© Karsh, Ottawa, 1973).

Diagnostic

Imaging

The incredible complexities of the body's interior – secrets only the surgeon could once examine – are being unfolded today with an array of "bloodless" scalpels.

What began nearly a century ago with Roentgen's discovery of the miracle of X-rays, has exploded into an era in which virtually every organ and its tiniest components can be studied without anesthetic and potentially risky surgery. And

that are essential for function or survival. A patient, for example, suffers symptoms such as the chest pain of angina. This is a signal from a heart not getting enough life-supporting oxygen and doctors may suspect either a blocked artery or one becoming clogged to the point where inadequate oxygenated blood is passing through it.

When an individual suffers a potentially devastating stroke, a critical blood pipeline to the brain may have been blocked. Or, in a more subtle, but potentially stroke-warning transient ischemic attack, the blood flow to the brain may be being slowly cut off. It is vital to identify the source before a disaster occurs.

To help pinpoint the precise location of the blood flow interruption, doctors today have at their disposal many diagnostic imaging tools ranging from the computerized axial tomograph (CAT) scanner to devices known as angiography systems.

A patient with a suspected blockage, receives an injection of a radio-opaque dye which can be observed as it moves along the bloodstream. It will quickly provide an outline of the vascular tree and identify areas of vessel-narrowing or a critical area of blockage.

One such unit is the Angicon system, produced in Canada by Picker International Canada Inc., a major international designer and manufacturer of diagnostic imaging tools, including CAT scanners and standard X-ray machines and their components.

The system makes possible instant filming at any angle of viewing or magnification, and eliminates the "fluoro-to-film changeover" delay inherent in some machines.

The Angicon is a "microprocessor controlled bi-plane angiography system" with a "true see-through film changer", a feature that permits the radiologist a fluoroscopic preview of the area that needs to be X-rayed. This not only speeds up the procedure but results in fewer repeat examinations and, accordingly, less exposure of the patient to radiation.

A video disc recorder makes possible evaluation of the procedure immediately after injection of the dye or contrast material.


The Angicon has "variable pulse fluoroscopy" going as low as 7.5 pulses per second, which also helps reduce exposure of operator and patient to higher doses of radiation common in continuous fluoroscopy devices.

Picker International's other product lines include "cassetteless" diagnostic X-ray fluoroscopic units capable of performing the work of two or more standard X-ray rooms, as well as an automatic chest X-ray system designed around the concept of a vacuum exposure chamber with automatic film transport from a loading magazine.

it can often be done with minimal exposure to radiation.

It is called "diagnostic imaging". With this marvel, doctors are not only able to pinpoint abnormalities that may or may not require correction, but they can actually view the ongoing performance of an organ system.

The human body needs adequate blood circulation to carry fresh oxygen to its many organ systems



This angiography system produced by Picker International Canada Inc., is used to obtain diagnostic images of blood vessel activity inside the body for signs of artery narrowing and possible blockages.

Packaging Pills

"Just a spoonful of sugar helps the medicine go down, in the most delightful way."

That bit of lyrical, pharmaceutical advice fell on the ears of millions of movie-goers around the world from the delightful voice of Julie Andrews, the "magical nanny", Mary Poppins, in the film of the same name.

Perhaps sugar does help some of us swallow our medicine, but modern capsule technology is adding its own important twist to pill-taking, a vital component of world-wide health care.

Numerous studies have shown that patient compliance, or rather lack of it, is a major problem in bringing about effective cure or control of illness, ranging from blood pressure to heart disease. This is a particular problem with many chronic diseases where the illness is "silent", largely without symptoms.

Another major problem is the danger of older patients, sometimes confused, often taking several drugs, mixing up their prescriptions. This may lead to their taking too much of one and little or none of another.

Some people simply have trouble swallowing pills, notably those in tablet form – with or without sugar.

And finally, the spoon, for all its other uses, is not always the most accurate method of dispensing medicine, unless it is full.

Hence, the gelatin capsule, which many doctors see as the choice form of oral drug for prescriptions of everything from powders to granulates, tablets or pellets.

Capsule Technology International of Windsor, Ontario, is emerging as a major manufacturer of hard gelatin capsules and the sophisticated machinery required to produce them. Capsules are made of pure gelatin, and titanium dioxide is used as a pigment for production of opaque capsules. The company is also heavily involved in technology transfer and the setting up of turnkey plants relating to the manufacturing of both soft and hard gelatin capsules.

Recent developments have also made possible the filling of capsules with medications in both paste and semi-liquid form. Capsule colouring, an important fac-

tor in helping to avoid confusion in drug-taking, is available in single or double tones as well as opaque and transparent.

Capsules, which must meet physical standards of size, wall thickness, moisture-content and customer colour specifications, are checked for possible microbial contamination and can be produced at an hourly output of 40 000 to 45 000, depending on capsule size.

After final inspection, all capsules undergo sterilization with ethylene oxide (12 per cent), which penetrates the capsule walls.

Imprinting of capsules with name or trademark is also available.

Recent studies have demonstrated a 15 per cent annual increase in capsule products and company officials believe that the paste or semi-liquid medication will eventually permit hard gelatin capsules to replace many soft gelatin types, thus opening up a large new market for the hard capsule industry.

The firm provides both building design and three months of training in operation of machines as well as in laboratory procedures related to raw material testing and product assays. It also provides training on site after the machines have been installed.



A capsule-manufacturing machine.



Gelatin capsules.

Lasers in Eye

Surgery



Cataract surgery that once took hours can be performed in minutes without anesthetic with this solid-state laser surgery system manufactured in Canada.

One of the prices of aging is the possibility of impaired vision. While glasses may help most people, thousands of others develop the more serious problem of cataracts.

There are two types of cataract. A primary cataract is the clouding of the natural lens of the eye and the treatment is a surgical procedure to remove the natural lens and the implantation of an artificial lens. However, following this, a secondary cataract, which is a cloudy membrane that forms on the inside of the artificial lens, may develop. Cataracts generally result in drastically impaired and cloudy vision and, if left untreated, can lead to near blindness.

Until a decade or so ago, cataract-removal involved extensive eye surgery and long hospitalization owing to the need to immobilize the patient's head during recovery. Long periods of confinement to bed are not recommended, particularly for the elderly, who comprise the majority of patients with cataracts.

But new surgical techniques have been developed to remove primary cataracts through a suction technique resulting in little or no hospital stays for patients in major health care centres.

Laser technology, now being used in many areas of surgery, has found a major role in the repair of eye damage ranging from detached retina and micro-hemorrhages in diabetics to the removal of secondary cataracts.

A Canadian firm, Lumonics Inc., located in Kanata, near Ottawa, has developed a laser system specifically designed to correct this problem. The laser concentrates light energy into short intense bursts that produce tiny one-tenth of a millimetre cuts to



remove the secondary cataract. It does so by passing through the artificial lens of the eye without damaging it.

The system, which employs a JK Lasers ND:YAG laser for the actual surgery, along with a small, low-power visible aiming laser, has made secondary cataract-removal an out-patient procedure, requiring no anesthetic.

Lumonics Inc., the third largest manufacturer of commercial lasers in the world, was an early leader in the field of pulsed gas laser technology for scientific applications. It specializes in the development and manufacture of pulsed gas lasers such as carbon dioxide and excimer lasers for scientific, medical and industrial marking applications.

Diagnosis

Just as an eye test is essential for prescribing the correct lenses for a person needing glasses, detailed studies of the inside of the eye are necessary to produce artificial lenses needed to replace natural ones. The eye specialist must determine precisely a whole range of measures such as axial length, anterior eye chamber depth and lens thickness.

Radionics Medical Inc., of Scarborough, Ontario, has designed and manufactured several ultrasonic devices capable of obtaining this important information. The technique involves transmitting low power pulsed ultrasound into the eye through direct contact on the cornea.

Each pulse produces echoes back from the surface of tissue which are, in turn, received by a transducer and then interpreted by a microprocessor. If this micro-process is satisfied that the readings are valid, the data and measurements are automatically frozen on a screen.

The machine, in addition to its capacity for obtaining biometry functions, is equipped with a "diagnostic mode" used to assess disorder within the eye including detached retina, vitreous hemorrhages or locating foreign bodies.

The firm also manufactures a device capable of mapping the various thicknesses of the cornea.

Yet another of its product lines is a non-invasive ultrasonic device for diagnosis and treatment of paranasal sinusitis, the presence of fluid in the maxillary and frontal sinuses of the head. The device transmits sound into the suspect sinus cavity where, if all is normal and it is air-filled, no echo will return from the back wall of the sinus. However, if it is water-filled, a strong response is obtained, which confirms sinusitis.



The two photos show an occulometer device for taking internal eye measurements; and a corneomap for mapping cornea of the eye. Both are manufactured by Radionics Medical Inc. of Scarborough, Ontario.

Hearing Impairment

The ability to communicate is essential. Where it is not possible, isolation with all its inherent hardships, is the end result. A human being unable to interact verbally because of speech or hearing loss is alone in a crowded world isolated from friends, family and society and often cut off from meaningful employment.

Speech and language handicaps respect no racial, social or political boundaries. They are a universal disability and, with some allowance for countries where certain epidemic illnesses are more rampant, affect 5 to 10 per cent of the population. The percentage grows as people age and live longer.

Such handicaps are caused by many factors, ranging from subtle neurological problems during

pregnancy, to a lack of stimulation in the home, head injuries, strokes and viral diseases.

Hearing impairment, besides its obvious problems, is also a major contributor to both speech and language obstacles. Where either problem exists resulting in an inability to absorb the spoken word or responding, learning is impaired as well.

Children slow in developing language skills necessary for understanding and expressing thoughts and ideas are at high risk of developing learning problems in school, since oral language skills – listening and speaking – are the foundation for written language skills. Voice disorders involve improper pitch, tone loudness and quality of speech.

Hearing impairment – something often missed or denied by parents as existing in their child – often manifests itself in the form of poor speech and language development. The longer the impairment goes undiagnosed the more difficult eventual treatment will be.

In Canada, where, according to estimates, more than 10 per cent of six-year-old children starting school have some impairment of speech, language or hearing, several companies have designed and developed sophisticated tools for diagnosis and treatment of such handicaps.

Madsen Electronics (Canada) Limited, of Oakville, Ontario, manufactures a full range of audiometers for testing of hearing levels, including pitch and tone.

A digital screening audiometer makes possible testing for hearing levels ranging from –10 to 190 decibels in five-decibel steps at eight frequencies from 250 to 8 000 hertz. The device, which is portable weighing only two kilograms, operates on both alternating and direct (battery) power

supplies, the latter an option.

A “brain stem responsive audiometer” can be used for both hearing and neurological testing of the auditory brain stem response.

For children suffering from impaired hearing, a speech training device is available to teach control of speaking. It is an aid in both assessing and treatment of voice disorders. The system’s screen is capable of displaying speech behaviour associated with fluency disturbances, such as pausing and rhythm characteristics. The device can also be used to help develop good voice pitch and efficient articulation. It can display the contrast between good and poor articulation characteristics, voice onset, intonation, pause, loudness and rhythm. As an aid to the teacher, who is the ultimate key to improved and effective speech, the system is also useful in teaching consonant and vowel characteristics as well as intonation and stress patterns of another language.

A range of “evoked potential” measurement devices is also available, including a current stimulator to permit neurological investigation. With a visual pattern screen stimulator option, evoked potential investigations can also be performed visually.



This visible speech-training system can be used for hearing impairment problems, teaching a new language, as well as speech and voice improvement.

Device

Development

Pinpointing the precise site and extent of abnormalities causing blockages or reduced flow of blood in arteries and veins is vital to successful surgery.

Non-invasive ultrasound diagnosis where sound patterns are returned from internal body tissues and organs is an important modern tool for certain conditions – normal and abnormal – ranging from aging of a developing fetus to assessing the status of blood vessels.

A compact, hand-held, ultrasound "micro doppler probe" developed by a Canadian firm is being used for a number of diagnostic procedures today. The device, produced by Bach-Simpson Limited, of London, Ontario, was originally designed for assessing the status of artery bypasses of the superficial temporal and middle cerebral arteries of the brain. Small and flexible as it must be for this delicate procedure, the tool is also useful for detecting "technical defects" following surgery on

blocked carotid arteries – carotid endarterectomy – in the neck.

In gastrointestinal surgery, where it is important to know the most distal or distant portion of the superior mesenteric artery with a compromised blood supply, the micro probe, because of its small "crystal" area, does not require the use of ultrasound surgical gel. In addition, its small diameter ensures that the signal being obtained is from the actual blood vessel route under observation.

The same company, which manufactures a number of ultrasound instruments, produces a bi-directional doppler blood velocity meter for measuring both the direction and velocity of blood flow in the major arteries and veins using accepted non-invasive ultrasound techniques to determine the location of an obstruction in an artery. It is further useful in diagnosing deep vein blockages.

A fetal heart detector manufactured by this firm will detect fetal life, single or multiple pregnancies as well as status of the fetus as early as the eighth week of pregnancy.

All probes produced by the firm are designed for gas sterilization.



Micro "doppler" probe for detecting abnormal blood flow in arteries and veins, made by Bach-Simpson Limited.

"It is well known that the pestilential fevers, phthisis and many other diseases are liable to seize on those who live with the infected, although they have come into no direct contact with them. It is no small mystery by what force the disease thus propagates itself...."

Though it was put to the quill nearly five centuries ago, this statement by Girolamo Fracastorius, the Italian poet, physician, mathematician, astronomer and geologist, displayed his remarkable insight into the modern concept of the nature of infection.

It was the terror of spread of disease through infection that gave hospitals their "death house" image well into the nineteenth century, until Joseph Lister introduced a carbolic acid spray to disinfect the air in operating rooms. It involved the principle of antiseptics – the killing of germs, not asepsis – germ-free air.

Today, a germ-free, pure environment is no less vital than the urgent quest for it was in the epidemic era of cross-infections like childbed fever. It is however, vastly more essential in this modern era of long, complicated surgery on internal organs, bones and joints, surgery that historically was only possible on the autopsy table and of risk only to the anatomist.

Clean air is not only critical in the surgical suite but throughout hospitals and laboratories where testing goes on continually on potentially disease-spreading or-

ganisms. It is equally needed in a great number of other research settings where both deadly organisms and highly toxic substances are studied. Depending on the level of potential danger, air purification standards rise constantly to the highest range of containment and isolation from the outside environment.

The critical component in obtaining a pure, safe atmosphere is a constant air flow and exchange and highly refined filtration systems capable of capturing and filtering out minute particles.

Several Canadian firms have become major suppliers of state-of-the-art air flow filtration systems designed and manufactured to meet the most rigid of international air quality standards.

One manufacturer, Canadian Cabinets Company Limited, located in Nepean, Ontario, near Ottawa, produces modular-design environmental air control equipment ranging from biological containment hoods to vertical and horizontal laminar flow work stations, laboratory fume hoods, animal isolation units, wet benches and glove boxes. Suspended vertical laminar flow systems are also available.

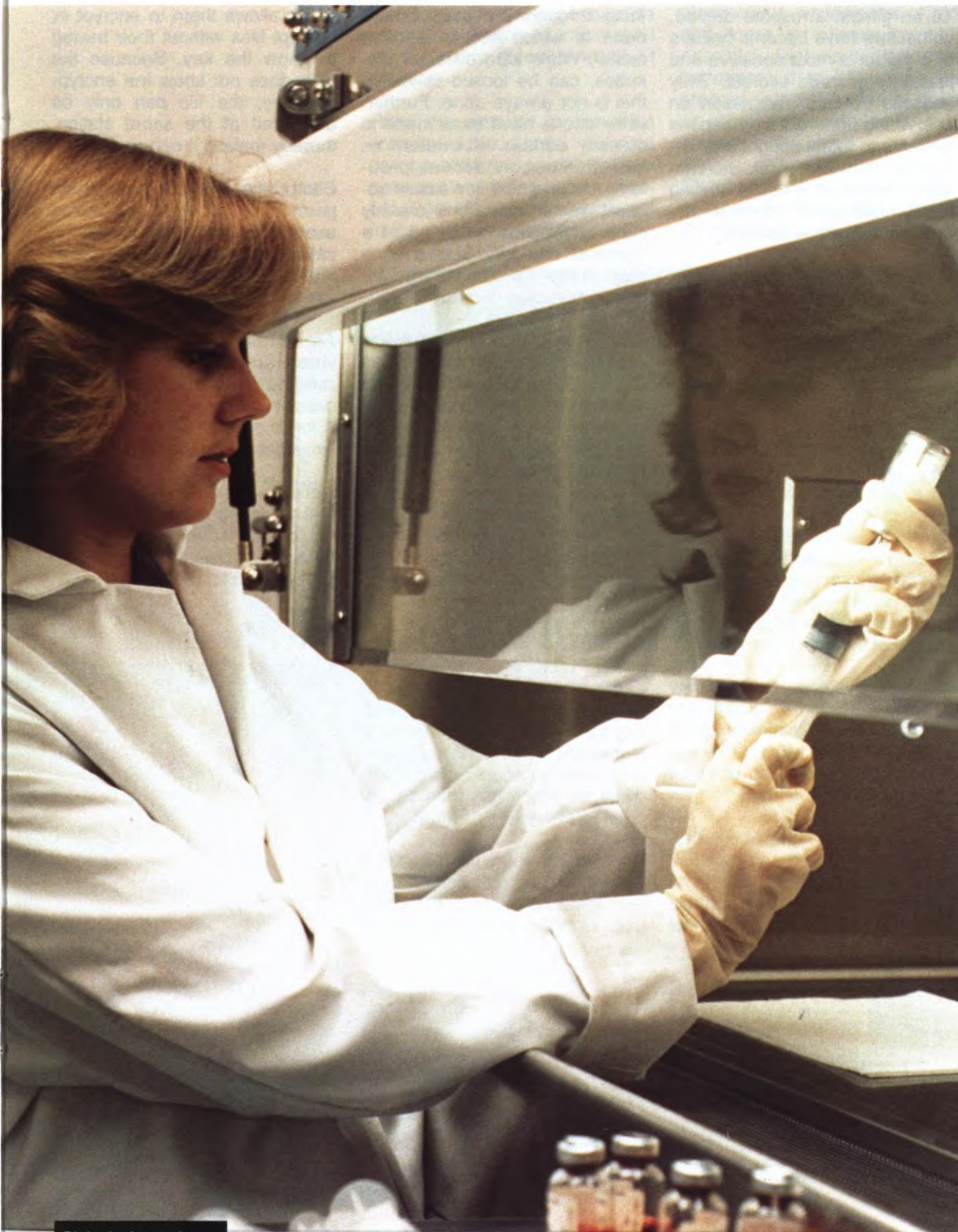
Using a patented "zero bypass plenum airseal", the laminar flow stations ensure that only high efficiency particulate air (HEPA) filtered air passes into the work area. The units exceed Class 100 conditions under federal standard 209B. These filters have efficiency ratings of either 99.97 or

99.99 per cent in removing particles smaller than 0.3 microns. It is only with such clean air environments that many processes are reproducible and that certain products can be manufactured.

Biological containment hoods provide a high degree of protection to both worker and product in handling low-to-moderate risk biological agents. With their HEPA filtered exhaust systems, and depending on the agents being handled, the units may be operated without any external venting. They are negative of pressure with automatic dampers on recessed faceshields. Options include air, gas and vacuum petcocks, duplex electrical outlets, ultra-violet light and ground fault interrupter circuitry.

The firm produces modular clean rooms from the Class 100 to Class 100 000 range.

Laboratory workers handling pathogens and isotopes require special environments; such rooms operate at negative pressure with HEPA filtering of both incoming and exhausting air.



Biological containment hood manufactured by the Canadian Cabinets Company Limited.

Amsco Canada Division of Ingram & Bell Ltd., of Brampton, Ontario, produces autoclave and steam sterilizers besides its other product lines such as operating room lights, treatment and examining tables.

Starplex Scientific of Mississauga, Ontario, manufactures, among other products, sterilizer supplies and sterilization packs as well as antibacterial and autoclaving bags along with aerobic and anaerobic transport systems.

Coldstream Products of Canada Ltd., of Winnipeg, Manitoba, produces a range of controlled environment rooms as well as freezers and refrigerators for clinical, blood bank and food use.

Isolation Systems Limited of Etobicoke, Ontario, near Toronto, is a major supplier of a range of hospital monitoring systems for detection and monitoring of gases and electrical current leaks, as well as biomedical electronic safety equipment. It also manufactures wall-unit patient monitoring systems for patient rooms, coronary cases and intensive care areas.

Computers and Confidentiality

To an almost awesome degree, computers have become holders of a person's most sensitive and jealously guarded secrets. They possess delicate information on everything from military weapons systems to much sought after industrial formulae. And, increasingly, they are the vaults holding highly confidential medical records on millions of patients.

Protecting that information from "unauthorized eyes" is vital not only from an ethical point of view but because of the potentially explosive legal ramifications of unauthorized disclosure.

Patient confidentiality, the commandment of Hippocrates, is paramount, and where humans have chosen to place this onus on inanimate electronic computers, a parallel responsibility emerges — its security. As with any computer network, however, certain people must have access to specific information in the course of caring for patients.

Isolation Systems Limited, has developed "Enigma", a data protection storage system to guard sensitive information while not making the process so complex as to discourage its use.

Where only mainframe computers once stored and provided data, personal computers (PCs) operating as remote or portable terminals are now doing the same

thing through the use of hard disks to which access is often easier. While hard disks, or diskettes, can be locked in vaults, this is not always done. Further, while efforts have been made to classify certain information as sensitive or confidential, problems occur when, for easier access, some institutions classify such information as being of a "general" category. Such a rating may, in the process, ignore adequate protection of data.

The Enigma incorporates a key management system which, according to the manufacturer, provides a rapid, easy way of using an encryption or ciphering facility to protect stored data on either hard disk or diskette.

The facility can encrypt a 1 000-byte file in 0.6 seconds using a diskette drive. On hard disk it is even faster. The user has a choice of either encrypting a file under a unique "self-nominated" key or a "default" key assigned to the particular PC station. A file encrypted under a user-nominated key can only be accessed by that user since the same key is needed for decryption. This technique permits transportation of encrypted diskettes which can then be decrypted at the end destination.

An alternative feature permits a security officer to designate a default key for all authorized individuals using a particular station,

which allows them to encrypt or decrypt files without their having to know the key. Because the user does not know the encryption key, the file can only be decrypted at the same station, thereby making it non-portable.

Each station in an Enigma system permits up to eight authorized users who use a log-on identification and password; users can change their passwords at each log-on.

An anti-tampering feature provides an automatic response ranging from invalidation of a password to complete shutdown. A log is created on all tampering violations for later analysis.

Isolation Systems also manufactures a range of systems including a line isolation monitor for detection of electrical leakages in critical hospital areas.

Blood Analyzers

Blood, on which life depends, also contains a wealth of information on the body through which it courses.

From the simplest to the most complex of blood tests, vital data can be obtained on the uniqueness and well-being of the individual. From blood type, so essential in the event of a transfusion, to a

blood count, an indicator of hidden illness, an intimate insight is essential. Analysis of blood may be essential to determine the amount and distribution of drugs or other potentially toxic substances in the blood.

Blood analysis provides a variety of other important information on its make-up, including such es-

sential data as the level of lipids like triglycerides and cholesterol fats in the blood which may be contributing to accelerated atherosclerosis or hardening of the arteries.

The more insidious the state of the illness the more information may be needed on blood and its circulating components. And in today's increasingly busy hospitals and clinics that takes time.

Several Canadian companies, including Équiment Moniteur Inc. of St. Eustache, Quebec, produce the latest in automated blood chemistry analyzers.

It manufactures a biochemical analyzer that works round the clock, seven days a week, thus avoiding the need for separate analyzers. Its unit, employing a special reagent dispensing system using one pump per reagent, eliminates any possibility of cross-contamination problems.

Pre-coded patient identification labels guard against error. The label is fixed to the "cuvet" holder and a bar-code identifies the patient sample. Each position on the holder corresponds to a specific analysis and each holder can handle up to eight chemistry readings.

The analyzer operates at a fixed rate of 80 patients an hour, regardless of the number of chemistry tests required.



The "Concept 2000" blood analyzer manufactured by Équiment Moniteur Inc. of St. Eustache, Quebec.

The Elderly and Handicapped

As a people we are aging in ever-increasing numbers. Improved living standards, better nutrition, safe drinking water, effective sewage treatment, victory over the era of infectious childhood diseases and near miraculous advances in medical treatment of illness, have all played roles in not only keeping more people living but living longer.

The increase has already begun and will have its most profound impact by the turn of the century, when the percentage of elderly will be nearly double its present rate. Health care planners, including governments, are already trying to grapple with the expected impact and the changes it will spawn in the approach of many issues, ranging from health care to housing of the elderly.

As the percentage of older people rises, the number in need of health care services also rises. While growing old is not always synonymous with growing sick, the fact is the elderly consume a disproportionately higher portion of health care dollars. Most, however healthy at the moment, will eventually require some care.

Besides meeting the needs of the elderly, health care workers are all too familiar with the horrendous toll that today's high speed motorized environment is inflicting on younger people. And because of their capacity to bounce back after what might otherwise be a fatal mishap, thousands of young people are saved through the wonders of intensive care treatment. Many, unfortunately, are left permanently and sometimes severely disabled. Depending on the nature of their disability, patients may require anything from abdominal belts to wheelchairs and washroom aids.

Meeting the needs of disabled and handicapped individuals in hospitals, nursing homes, rehabilitation facilities or at home, is a major challenge to the health care industry in Canada, which has been taken up by many companies. The following paragraphs list a few of these firms and the products they manufacture.

Power wheelchairs are manufactured by Équipement de Transmission (Ind.) Inc. of Ville Vanier, Quebec; chair lifts for stairs, as well as wheelchairs, are produced by Garaventa (Canada) Ltd. of Surrey, British Columbia; and two St-Hyacinthe, Quebec firms, Les Entreprises Elevabec Inc. and Les Escalateurs Atlas (1979) Ltée, also specialize in wheelchairs and wheelchair lifts.

Crestline Coach Limited of Saskatoon, Saskatchewan, also manufacture wheelchairs, as well as ambulances and buses for the handicapped.

Calm Handicap Supplies Inc. of Kelowna, British Columbia, produce all types of hospital bed equipment for functional positioning and therapeutic equipment and hospital training dolls.

Med-Ex Diagnostics of Canada Inc., of Port Coquitlam, British Columbia, manufacture rehabilitation chairs, modular therapeutic exercise equipment as well as orthopedic diagnostic exercise apparatus and lower limb artificial prosthetic devices and orthopedic goniometers.

Physical therapeutic and all types of prosthetic and rehabilitation equipment such as traction apparatus, walking aids, arm slings and knee supports, can be supplied by Montreal companies J. Slawner Ltée and Medicus Ltée;

another Montreal manufacturer, Systèmes Médicaux Inc., produces height-adjustable kitchen systems, eating aids for the handicapped and other rehabilitation equipment.

Venco Products Limited of Richmond, British Columbia, manufacture portable bathtubs, whirlpools, therapy apparatus, saunas and vibrating beds, while Whirlteq of Fredericton, New Brunswick, supplies hand-controlled motor vehicles, various types of wheelchair lifts and other equipment including food preparation equipment.

Acme Furniture Ltd. and Westin-Ofa of Canada (1979) Limited both of Winnipeg, Manitoba, and Ven-Res Products Limited of Shelburne, Nova Scotia, supply, among other products, orthopedic and geriatric chairs and furniture for waiting rooms and surgeries.

Bard Canada Inc., of Mississauga, Ontario, supply a long list of hospital equipment, ranging from urine and other collection bags, to cannulas, carts, catheters, humidifiers, oxygen masks and tents, sterilization supplies, disposable surgical kits and trays, syringes and stretchers.

Insulin Injections –

No Need for Needle

Millions of diabetics face a daily ritual of giving themselves injections of insulin to control their disease. The traditional method has been with a needle. But now a Canadian firm, Advanced Medical Technologies Inc., of Charlottetown, Prince Edward Island, produces an advanced technology power injector device that injects insulin under the skin without the use of a needle.

The injector delivers insulin under pressure through a tiny orifice that penetrates the skin painlessly to spread insulin evenly beneath.

The insulin vial with its disposable vial holder is attached to the injector to fill it, then the handle is turned counter-clockwise to load the injector with insulin. Even a diabetic with sight problems can use the device because a "click" is felt as each whole unit is loaded. The vial holder is removed when the desired number of units have been filled. As the user fills the unit the number of units loaded can be seen through a window lens on the injector. The device accepts two types of insulin and can be filled to within half a unit. It has a capacity of 50 units of U-100 insulin.

If varied insulin injections are required, a second vial replaces the first, and the same procedure is followed.

The injector is equipped with a "backing off" feature which permits the patient to adjust the pressure by five variable settings to adapt to skin resistance. Experimental injections can be "practised" using bacteriostatic saline solution.

Some physicians report that the small, accurate device, which can be sterilized easily, actually reduces daily insulin requirements.



This compact insulin injection device, which eliminates the need for needles, is produced by a Canadian firm, Advanced Medical Technologies Inc.

Medical Advances

Over the Years

The discovery in Canada of life-saving insulin by Banting and Best in 1922 as a treatment for diabetes, not only offered new hope for millions of victims but drove home a message to scientists and laymen all over the world that Canadian medical researchers were among the best anywhere.

The Nobel Prize awarded to Sir Frederick Banting resulted in several major long-term benefits. It spurred an unprecedented interest in medical research in Canada and attracted financial support for researchers, foundations and other groups.

In the decades since that discovery, medical research has continued to expand in Canada where, in the past 20 years alone, the number of medical schools with research facilities has doubled.

These research efforts have resulted in a number of Canadian breakthroughs including:

The first "cobalt bomb" for the treatment of cancer.

Discovery of the anti-cancer drug vinblastine.

Research uncovering a carcinoembryonic antigen "marker" and a radioimmunoassay method of early detection of cancer.

A simple method of preventing fatal Rh disease in infants and reduced infant mortality through improved nutrition.

Work by Dr. Arthur Vineberg, who devised the first heart bypass surgical procedure.

The electron microscope, which was first made in Toronto.

Pioneer work in the surgical use of lasers and in the development of uses for non-invasive diagnostic equipment.

New knowledge of the brain and pioneer surgical techniques, including the treatment of epilepsy by Dr. Wilder Penfield.

Intimate new understanding of stress and its impact on the body by Dr. Hans Selye.

Isolation of the parathyroid hormone and discovery of methods for isolating the pituitary and placental hormones by Dr. J.P. Collip.

The world's first cardiac surgery using hypothermia or lowering of the body temperature, by Dr. William Bigelow and colleagues who developed the first heart pacemaker for continuous use in human beings.

Dr. C.P. Leblond's discovery of how iodine is taken up by the thyroid gland which led to new treatments for thyroid disease.

Development of the first spinal pacemaker to stimulate growth in children with spinal deformities by Dr. W.P. Bobeckko.

Discovery of the sex chromosome by Dr. Murray Barr.

Cell culture research by Dr. Raymond Parker that was vital to eventual development of a vaccine for polio.

The isolation of estrogens by Dr. R.D. Haard.

Isolation by Dr. Henry Friesen and colleagues of the human prolactin and discovery of new diseases related to it.

Today, major research into a variety of complex medical problems ranging from heart and brain to autoimmune diseases is being conducted by Canadian medical researchers.

Intensive work in major clinical trials is under way using the anti-rejection drug cyclosporine for both organ transplants as well as in attempts to cure or arrest juvenile diabetes.

At University Hospital in London, Ontario, where international trials that revealed the value of acetylsalicylic acid in preventing heart attacks and strokes were co-ordinated, renowned neurosurgeon Dr. Charles Drake, carries out brain surgery that has made this centre one of the foremost in the world for such procedures.

At the same hospital specialists, in collaboration with Biomedical Instrumentation Inc., a Toronto, Ontario research and development firm, are producing a sophisticated cardiac mapping device expected to greatly advance the surgical treatment of potentially-fatal heart rhythm disorders. The computer-assisted device enables doctors to rapidly locate electrical short circuits in the hearts of patients suffering from diseases like Wolff-Parkinson-White syndrome.

Conclusion



Culture media preparation inside a horizontal laminar flow work station.

The foregoing is a brief general overview of developments in Canadian medical technology and products. It is not possible to draw a fully comprehensive picture in a publication of this size.

Companies mentioned were selected by the author and are listed on the following pages. Further information on health care products manufactured in Canada, and a complete directory of the companies and products, can be obtained either from the Health Care Products Division, Chemicals Directorate, Department of Regional Industrial Expansion, 235 Queen Street, Ottawa, Ontario, K1A 0H5, telephone (613) 993-4471 or through your nearest Canadian embassy or high commission.

**List of Companies
and Institutions
Referred to in this
Publication**

ACME Chrome Furniture Ltd. 211 Hutchings St. Winnipeg, Manitoba R2X 2R4	Biosig Instruments Inc. 5471, ave Royalmount Montréal, Québec H4P 1J3	Équipement de Transmission Inc. 500, rue Desrochers Ville Vanier, Québec G1M 1C2
Tel: 204-633-8432 TELEX: 07-587699	Tel: 514-733-3362 TELEX: 5822790	Tel: 418-681-0667 TELEX: 051-3855
Advanced Medical Technologies Inc. P.O. Box 8 West Royalty Ind. Park Charlottetown, P.E.I. C1A 7K2	Calm Handicap Supplies Inc. 452 Christleton Ave. Kelowna, British Columbia V1Y 5H7	Équipement Moniteur Inc. 445, boul. Industriel St-Eustache, Québec J7R 4J9
Tel: 902-566-3229 TELEX: 014-44238	Tel: 604-763-9387	Tel: 514-472-6620
AMSCO Canada, Div. Ingram & Bell Ltd. 255 Queen St. Brampton, Ontario L6W 2B9	Canadian Cabinets Limited 25F Northside Rd. Nepean, Ontario K2H 8S1	Garaventa (Canada) Ltd. 7505-134A St. Surrey, British Columbia V3W 7B3
Tel: 416-451-4410 TELEX: 06-97539	Tel: 613-829-1433 TELEX: 053-3590	Tel: 604-594-0422 TELEX: 04-55763
Atomic Energy of Canada Ltd., Radiochemical Company 413 March Rd. Kanata, Ontario K2K 1X1	Capsule Technology International 2001 Heron Church Rd. Windsor, Ontario N9C 2L6	Isolation Systems Limited 26 Six/Point Rd. Etobicoke, Ontario M8Z 2W9
Tel: 613-592-2790 TELEX: 053-4162	Tel: 519-969-5404 TELEX: 064-77665	Tel: 416-231-8033 TELEX: 06-984737
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Tel: 519-452-3200 TELEX: 064-5843	Tel: 204-669-1201 TELEX: 075-7152	Tel: 514-731-3378
Bard Canada Inc. 2345 Stanfield Rd. Mississauga, Ontario L4Y 3Y3	Crestline Coach Limited 802-57th St. Saskatoon, Saskatchewan S7K 5Z1	Les Entreprises Elevabec Inc. 15740, rue Demers St-Hyacinthe, Québec J2T 3T8
Tel: 416-275-8000 TELEX: 06961498	Tel: 306-934-8844	Tel: 514-773-9977
Biomedical Instrumentation 72 Steeles Ave. W., Suite 204 Thornhill, Ontario L4J 1A1	Eldorado Mining and Refining Limited Now Eldorado Resources Limited Suite 400, 255 Albert St. Ottawa, Ontario K1P 6A9	Les Escalateurs Atlas Ltée 635, boul. Laurier St-Hyacinthe, Québec J2S 7B4
Tel: 416-731-3599	Tel: 613-238-5222 TELEX: 0533382	Tel: 514-773-6708
		Lumonics Inc. 105 Schneider Rd. Kanata, Ontario K2K 1Y3
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Picker International Canada Inc.
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