Canadian Conservation Institute

C.C.I. Activities

Preparations for the Conservator Training Programme have occupied much time of the C.C.I. staff over the past few months but by the time this Newsletter is published the programme will be well under way with the first intake of ten trainees spending the initial part of the course at the Atlantic Conservation Centre, Moncton.

The Progress in Conservation exhibition has continued in eastern Canada having opened at the Confederation Art Gallery and Museum, Charlottetown, Prince Edward Island, on 15 March and at Dalhousie Art Gallery, Halifax, Nova Scotia, on 1 May.

Several C.C.I. staff have given talks and contributed to seminars. Dr. Stolow spoke at the exhibition opening at Charlottetown and contributed to the C.M.A. seminar entitled 'The Care and Maintenance of Photographic Collections' at Ottawa 3–4 April. At the same seminar Mr. Roger Roche lectured on causes of deterioration and care of photographic prints, Mr. Roy Graf spoke on their display, Ms. Susan Nash outlined the technical history of photography and Mr. Wilfred Bokman discussed the care of photographic colour materials.

Dr. J.F. Hanlan has given a talk entitled 'Analysis of Museum Artifacts' to the Toronto-Hamilton section of the Spectroscopy Society of Canada in Oakville and, during April, another on analytical methods to the National Historic Sites training programme in the Conservation of Monuments. His work with Mr. R. Myers on the Canadian silver project, featured in an earlier issue of our Newsletter, is continuing.

During March Messrs. Wilfred Bokman and Ian Wainwright, both members of the Scientific Documentation Division, gave a course of talks and demonstrations on photography and microscopy to C.C.I. conservators. Apart from forming basic training for our own staff, the course served as a useful rehearsal for presentation of the same subjects in the training program.

This in-house training was followed by a most rewarding visit to C.C.I., 1–5 April, by Dr. Walter C. McCrone of the McCrone Research Institute, Chicago. The course 'Microscopy for Conservators' was attended by twenty members of staff, both conservators and scientists.

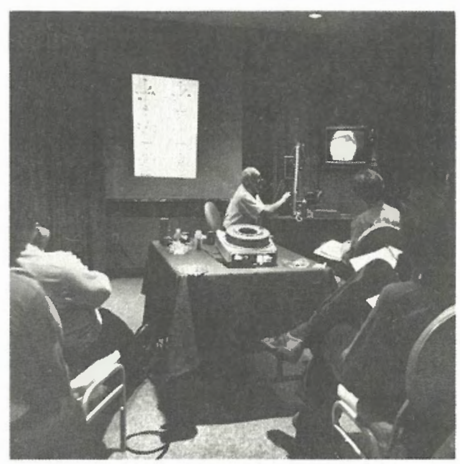
Each participant was furnished with a simple Olympus polarizing microscope and standard preparations of pigments and fibres. Further topics were covered in the lectures with the assistance of a video camera and superb slides. Even the more difficult problems in crystal optics and microscopical procedures seemed comprehensible owing to Dr. McCrone's lucid explanations and his attention to first principles.

During the following week we were fortunate in receiving a visit from Dr. A.E. Werner, Keeper of the British Museum Research Laboratory who came to offer his expert advice on conservation in archaeology and also gave a talk on recent developments in archaeological conservation, discussing various synthetic resins now available and methods for treating bronze and lead. This lecture was attended by C.C.I. staff and also by conservators from Public Archives, the Museum of Man, and National Historic Sites.

Mr. Per Guldbeck, Consultant Conservator Ethnology, visited the Manitoba Museum of Man and Nature at Winnipeg during April in response to a request for advice on conservation of the Paul Kane collection. This is a collection of North American Indian ethnographic material, essentially Woodlands and Plains cultures, that was collected by Paul Kane, artist of the mid-nineteenth century, who also painted various tribal groups. Mr. Guldbeck reported that he was very pleased with the conditions under which the collection has been preserved and with the care taken by those responsible for its storage and display. Some of his time was also taken up in consultation with Mr. Maurice Mann, conservation technician in charge, reviewing problems of laboratory functions and exhibitions and storage environmental conditions.

Mr. Emil Bosshard, Conservator Fine Arts, visited Europe in April, travelling to several museums in Paris and London. The basis of his trip was attendance at the Conference on Comparative Lining Techniques, 22–24 April, at the National Maritime Museum, Greenwich.

R. D. HARLEY



Dr. McCrone's lectures on microscopy were illustrated with the aid of a video-camera (Photo: W. Bokman)

M. McCrone illustre ses conférences sur la microscopie par des projections magnétoscopiques

Newsletter

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Conservation Queries

• *I am planning to store my collection of small wood artifacts in sealed plastic bags. Are there any serious hazards to the objects in using this technique?*

Plastic bag storage of wood objects has many advantages. Good quality bags with well-sealed closures effectively isolate the contents from many detrimental environmental factors. Airborne dust and dirt are excluded, thereby not only avoiding soiling but, perhaps as important, eliminating the hazards associated with handling while cleaning. Though not completely imprenetrable to corrosive gases such as sulphur dioxide and hydrogen sulphide and water vapour, the rate at which they can pass through the bag is so low normally they will cause no deterioration. Insects and fungus spores are also excluded. Finally, hygroscopic materials such as wood, when properly bagged, will maintain their initial moisture control.

What then are the major hazards?

The major problem is associated with the relative humidity (RH) in the bag. In the first place, to maintain an RH within, essentially unaffected by changes in temperature and external RH conditions, it is important that there is relatively little free air space. For example, one should avoid constructing a plastic 'tent' around a small object, for then, even with a perfect seal, the RH in the bag would undergo variation as the temperature changes.

Secondly, you should avoid direct contact of the object with the plastic film if there is any possibility that the storage temperature could drop below 13°C (55°F). As you know, when a surface (such as the inside of the plastic film) is cooled, it ultimately reaches a temperature at which water vapour condenses to liquid form – the dew point temperature. If you had sealed the bag with the 50% RH desirable for wooden objects the dew point would be approximately 53°F. Liquid water in contact with the wood could cause local swelling or distortion and loss of paint, gesso, gilding or other decoration. Metallic objects could develop corrosion spots. Some plastic films contain high concentrations of plasticizers; contact of the object with these can result in staining or adhesion to the film.

A second problem follows from the great transparency of most thin plastic films to ultraviolet (UV) radiation. Therefore, any object which is light sensitive should be protected from exposure to light with a significant UV component such as unfiltered fluorescent light or daylight. In addition, strong light on the bag would result in a temperature rise to intolerable levels.

A simple procedure to obviate these difficulties is first to wrap the object carefully in layers of white absorbent tissue paper before bagging. The paper isolates the object from the film and affords some screening of UV as well as providing additional hygroscopic material which helps buffer the contents against changes in RH. Of course the tissue prevents visual identification of bag contents so labels are necessary. Ungummed paper labels should be enclosed rather than affixing gummed labels which can become detached or weaken the plastic film.

As a final precaution you may wish to enclose some insect control materials such as paradichlorobenzene nuggets. These should not directly contact either the object or film; loose wrapping in separate tissue is satisfactory. However, even with such measures representative bags should be opened and contents examined at intervals to ensure absence of insect activity.

The simplest and most effective closure is made by heat sealing with a commercial device or (after a little practice) with a conservators' heated spatula or an ordinary household iron.

As a final precaution I should remind you that some species of wood, such as oak, liberate acidic vapours which in the sealed bag may reach high enough levels to damage metal components of an object.

• *What exactly are plasticizers? Which plastics contain dangerous amounts?*

Dr. J.F. Hanlan, Chief, Analytical Research Services, describes plasticizers as 'relatively low molecular weight organic compounds, typically esters of carboxylic or phosphoric acids, which are added to a wide variety of plastic resins in order to improve their workability, flexibility and low temperature usefulness or to impart some desirable surface property'. He adds that it is difficult to generalize about plasticizers because many hundreds of different commercial formulations are used in industry. The danger of plasticizers lies in their ability to migrate from the plastic to adjoining materials and to volatilize within closed containers. Light, heat, and excessive humidity can accelerate these processes.

It is also difficult to generalize about which plastics contain dangerous amounts of plasticizers because many variables must be considered. Polyethylene, polystyrene, nylon and mylar are usually free of such additives. However, coloured films of these materials have plasticizers added to enable them to accept the dyes. Polyvinyl and cellulosic plastics tend to be heavily plasticized. In high concentrations plasticizers have severe effects, for example, certain plasticizers can soften paint or produce acids that corrode metal. However, if a plastic is not in direct contact with the artifact and it is only used for a short period of time, the amount of plasticizers present would probably be negligible and not dangerous to works of art. On the other hand, an artifact stored over a long period tightly wrapped in plastic sheeting would stand a greater risk of being damaged by plasticizers.

One of the most widely used plastics, polyvinyl chloride, is dangerous, not so much because of its content of plasticizers, which is high, but because it produces hydrochloric acid as it ages and decomposes.

Prudence should always be used in the selection of plastic materials for use with museum artifacts, and an informed choice made on the basis of the best advice possible.

RUSTIN LEVENSON

Storage of pottery sherds using clear plastic boxes to minimize damage and improve ease of research (Photo: S. Nash)

Entreposage de tessons de poterie dans des boîtes de plastique transparent qui diminuent les risques de dommages et facilitent la recherche

From Dig to Museum

The value of a conservator to the field of archaeology can best be understood by examining the nature of the archaeological quest. The prehistoric archaeologist is basically attempting a reconstruction of a culture from the 'clues' preserved in the earth. Such elements as population size and distribution, types of dwellings, and food preferences aid in this reconstruction. Perhaps the site was used for seasonal hunting and fishing, or perhaps it was a settled agricultural community. Domestication of animals may be evident. The local climate and vegetation can be inferred with the help of geologists and pollen analysts. Changes in climate and vegetation are often reflected in cultural adaptation through changes in technology.

The information that remains for the Canadian prehistoric archaeologist is the form of changes in soil, pollen grains, foundations of buildings, hearths, bones, pottery, stone tools and weapons, and occasionally copper artifacts. Historic archaeology concerns itself with a site which has written documentation, such as a Hudson Bay Company Post.

The detection of clues has become quite sophisticated in the last twenty-five years. A conservator must be familiar with these analytical techniques in order not to use conservation treatments which will destroy data before it has been documented. If possible, especially in archaeological conservation, the artifact should be altered as little as possible by treatments. This will allow future analyses to be made when even more information can be obtained.

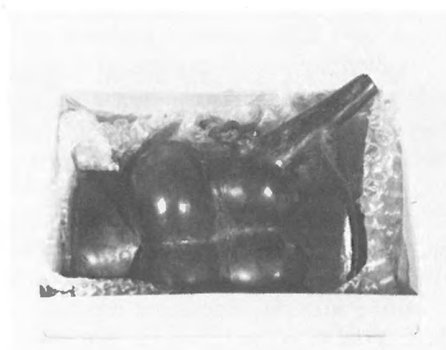
Two of the more common techniques and their dependency for accuracy on careful treatment may help to illustrate the requirement for a conservator's awareness. Radiocarbon dating counts the decay of C^{14} from the time a living plant or animal dies to the present. There are a certain number of radioactive carbons in all organic compounds including the synthetic resins universally used in conservation. To add more C^{14} to a sample by means of an impregnating agent, would make it look 'younger' than it is to the analyst. Thus all sampling for analysis must be done before certain kinds of conservation treatment can begin.

Thermoluminescence dating counts the amount of radioactive damage that has occurred during burial to fired pottery. Clays undergo this damage, but kiln firing eliminates it. If a pottery sherd is refired during restoration (a technique sometimes used in the past) the information for thermoluminescence will be wiped out. The pottery will appear 'new'. Conversely, radiation from x-rays will increase the radioactive damage to the clays and the pottery will then appear 'older' than it really is.

Metals are more commonly radiographed than pottery, and though no similar dating technique has been developed yet, a cautious view to the future might prove judicious. The errors in dating can be adjusted if the amount of radioactive dose has been carefully recorded. In fact, all analytical and treatment procedures must be meticulously recorded by a conservator, for just such reasons as these.

Besides analytical data, artifacts have many morphological characteristics useful to the archaeologist doing research. Dimensions, weight, colour, texture, and surface features are part of stone tools and weapons, pottery, and bones. These are the most commonly occurring remains in an archaeological site in Canada. The conservator should be aware of the sort of information the archaeologist wants from the artifacts and bones and conduct conservation treatment accordingly. For instance, it is important that the dimensions and surface features of bone should not be altered; impregnation should be undertaken with care, as solvents may swell and then shrink bone causing it to crack. A 'protective' coating applied only to the surface could shrink in time, crack and peel, taking the outer surface of the bone with it.

Storage conditions, which are almost always the responsibility of curatorial



Ceramic pot, Peruvian, stored in a box cushioned with bubble pack (Photo: S. Nash)

Poterie péruvienne en céramique préservée dans un emballage à coussins d'air.

staff, play what is perhaps the most important role in the preservation of a collection. There are two aspects to the problem of environment: the effect of changing relative humidity and the effects of mechanical damage on artifacts.

Peruvian textiles, Chancay, sewn to blue wrapping paper and folded, causing damage (Photo: S. Nash)

Tissus péruviens (Chancay) cousus à un papier d'emballage bleu et pliés, ce qui les endommage.

The relative humidity affects organic materials like wood, bone, ivory, leather and textiles when the moisture content of the material tries to adjust itself (come to equilibrium) to the ambient humidity. The material will either absorb moisture and swell somewhat or lose moisture, shrink and crack. For this kind of very sensitive material a constant RH around 50% is the condition most likely to maintain flexibility and internal strength in the artifact while not being so high that mould and insect life is encouraged.

With inorganic materials, like metals and pottery, a high or fluctuating RH presents different problems. Moisture is necessary to the continuing corrosion of metals. This is especially detrimental if chlorides from burial are still included in the corrosion layers of copper and iron. With moisture the chlorides form hydrochloric acid which quickly eats away whatever metal may be left. A dry storage condition with RH less than 25%, or the removal of the chlorides, are the only known ways of preventing the disintegration of the metal through further corrosion in storage.

Pottery may also contain any number of soluble salts from burial. Cyclic changes in RH will cause these salts to alternately dissolve and crystalize and the growing crystals lodge themselves on or just under the pottery surface. This causes flaking and loss of design, or in extreme situations the entire pot may collapse.

Mechanical damage occurs during excavation, in shipment, in handling, and in overcrowded or poorly designed storage conditions. In the field the shipping problem is one of either anticipating what kind of material will be excavated, or being in sufficiently close proximity to suppliers to respond to an emergency situation. A special case such as waterlogged wood will point up some of the many problems to be dealt with. Excavation cannot be conducted with the usual trowels because the wood can be as soft as butter. Adjustable water hoses are a solution – they keep the wood wet and gently separate it from the surrounding mud. To keep the wood wet until conservation can begin it must be sealed in plastic, usually strong polyethylene, and carefully packed for shipment in strong crates, cushioned within by sheet styrofoam. Such wood is in an extremely vulnerable state, even though it looks quite solid. At no time must it be allowed to dry out because it will shrink and warp out of all proportion. Samples for radiocarbon dating must be taken *before* any fungicidal or impregnating agent is used.

Two members of the Archaeological Survey of Canada using an adjustable pressure hose to excavate a water-logged deposit at Prince Rupert harbour, British Columbia (Photo: S. Holm)

Deux membres du personnel de la Commission archéologique du Canada se servent de tuyaux d'arrosage à pression ajustable pour déterrer un dépôt de bois imbibé d'eau, dans le port de Prince-Rupert (C.-B.)

In storage every single kind of artifact must be protected from mechanical damage. Nothing is immune, not stone tools nor 'flexible' textiles. If drawers are part of the storage system then cushioning materials, such as polyethylene 'bubble pack', can be included to absorb shocks. Collections of pottery sherds and stone and obsidian tools can be divided and contained in small clear plastic boxes to minimize the distances they have to slide in when the drawer is opened. The temptation to put objects in open boxes which are too small should be eliminated. If the object is merely resting on the rim it is not being protected at all. One solution for whole pots is to rest them in cushioned boxes. If shelves are used, some method of preventing pots from rolling off, such as a retaining lip, must be devised.

One of the cardinal rules in storing textiles is to avoid folding them. The fibres, particularly of archaeological textiles, are quite brittle and the folds will eventually become breaks. They should lie flat protected by acid-free tissue and supported on acid-free board. Mounting usually requires the skills of a conservator. Unavoidable folds should be stuffed with acid-free paper to prevent creasing.

Although this article is mainly concerned with archaeological collections, advice given for the storage and handling of ethnological collections is also applicable. The major consideration is the retention of information. Archaeology storage is like an archive of artifacts with each piece containing a variety of data.

SUSAN NASH

Photographs by Susan Nash were taken with the permission of the National Museum of Man.

The Environment and Collections

From their creation works of art and cultural objects begin reacting with the environment around them. Natural ageing effects, such as the appearance of craquelure on a painting or patina on a bronze, and deterioration effects, such as the cracking and flaking of a painting or the corrosion of metallic sculptures, are visible manifestations of chemical and physical reactions between the chemical components of the object and the chemical components of the surrounding environment.

In part one of the article, the roles of moisture, temperature, air and light in the deterioration of works of art will be described in general terms, and part two (to appear later) will deal with the added dangers of air pollution.

Practically all the materials of works of art are sensitive to changes in the moisture level of the surrounding air. The sensitivity can manifest itself, broadly speaking, in one of two ways:
(a) a change in the dimensions of the material as the relative humidity changes;
(b) physical deterioration due to chemical reaction with moisture and gases in the air.

Materials which react in the first sense are the hygroscopic materials canvas, paper, textiles of either natural vegetable fibres or animal fibres or modern synthetics, wood and animal skins such as leather, parchment, vellum etc. These materials all have a certain natural water content which will vary with the relative humidity of the ambient air. As the humidity increases, these materials will absorb water from the air, and as the humidity decreases, they will give off water to the air. These changes in their moisture content cause a change in their dimensions so that increasing humidity tends to expand these materials, decreasing humidity to contract them. This process is relatively fast, changes in moisture content and size occurring within minutes of the change in humidity, and will not disappear with age. A thousand year old wooden object will react to changes in humidity in a manner quite similar to a one year old wooden object. If the material is free to expand and contract, or if all parts of the material would expand and contract equally, changes in humidity would cause minor and insignificant damage. However, in paintings and polychrome wood sculptures the inflexible paint layer, which does not expand and contract but remains rigid, opposes these movements of the support material, creating stresses in the material leading to cracking, flaking of the paint as the bond between the paint and wood or paint on canvas weakens, leading ultimately to paint losses. Even unpainted wooden objects, if they are solid, can crack because the outside layers of wood will expand and contract more than the interior por-

Freeze-thaw cycles and moisture transport result in loss of paint and erosion of stone sculptures. Virgin and child, French, 15th century. The National Gallery of Canada, Ottawa

Les cycles de gel et de dégel ainsi que les mouvements de l'humidité à l'intérieur des objets produisent des pertes de matière ou même l'effet d'érosion sur des sculptures de pierre

tions of the wood, again setting up stresses in the object. Naturally, objects made of skins, such as leather drums, will crack and split if the movement of the material is opposed by a stretcher or frame, and parchment and vellum pages take on a wavy appearance, 'cockling' in high or very low humidities as they alter dimensions. Prints, drawings and watercolours react similarly leading to buckling in framed objects. Another factor of some importance is the loss in strength of paper with high humidity.

Thus, paper, wood, textiles, skins, paintings and canvas are all sensitive to moisture and moisture changes in the atmosphere around them, and care must be taken to stabilize the relative humidity of the ambient air to prevent deterioration from the physical changes in the material.

Stone, ceramics, architecture and metals interact with moisture in a more chemical fashion. We are all familiar with the rusting of ferrous metals which is a chemical reaction of the iron with oxygen and water to form a new chemical product that has many properties different from the original metal. Almost all the metals and alloys corrode in a natural atmosphere – even gold objects, because they are most often alloyed with copper for strength, do show evidence of deterioration. The corrosion of a metal generally leads to either a protective layer or a non-protective layer. Aluminum in a natural environment quickly forms a protective layer, as does bronze, and this layer prevents further corrosion of the underlying metal. Iron however does not form a protective layer during corrosion and thus gradually disappears over the years. Unfortunately, in the case of many copper objects the corrosion product is seen as an evident discoloration altering the aesthetic features of the object and its protective nature must be ignored. However, it should be remembered that removing a protective layer of corrosion whether on coppers, bronzes or aluminum objects without removing the agents of the corrosion simply leads to the formation of a new layer with further corrosion of the object. One of the most direct methods to prevent corrosion of objects is to limit the humidity of the air to around 50% or less; another is to insulate the object from the atmosphere by means of a protective varnish or a protective coating.

The major cause of deterioration in stone works and ceramics exposed to the atmosphere is changes in moisture and temperature. Stone objects and ceramic objects contain a certain amount of moisture and will absorb more moisture during periods of high humidity. If the moisture in the stone should freeze it will expand putting pressure on the stone around, forcing surface layers to fall off, creating cracks and holes in the stone. During a thaw more moisture can be absorbed through the holes and the cracks and if freezing occurs again more pressure is applied and more layers of stone are forced off. This becomes a major problem in architecture and in large stone objects exposed to the elements. Another danger arises from the movement of moisture through the stone, caused either by capillary action or by a difference in the moisture content of air on each side of the stone. In moving through the stone the moisture will dissolve and carry along soluble salts gradually bringing these to the surface where the water evaporates, leaving the salts to deposit on the object. Thus one gets efflorescence, a disfiguring build-up of salts on the surface; in a polychrome statue these salts can be deposited between the stone and the paint layers destroying the paint-support bond and allowing the paint layer to flake off. The appearance of salts on buildings usually arises from the difference in moisture levels between the inside of a building and the outside. In temperate climates this is particularly noticeable because of the variation in moisture experienced over the year and causes another problem for galleries and museums attempting to maintain high interior humidity during the winter.

Thus, almost all the materials of works of art can be seen to suffer from extremes of moisture or changes in the moisture level of the air around them. The most important first step to be taken in preserving collections is the provision of a stable temperature and humidity. Control of temperature is important not only from the standpoint of personal comfort of the visitors and staff but also from the point that temperature affects the humidity of the air and also, though to a lesser extent, the moisture content of materials. Desirable norms that minimize metallic corrosion and mould growth as well as the physical processes of deterioration would be 65°–72°F and 45–55% relative humidity. It is important to note that whatever level is established within this region, it should be maintained 24 hours a day, every day of the year.

For some institutions overall climate control in regard to humidity is financially or physically impossible and an alternative solution may be found in the sealed case, i.e. a case displaying the object which also holds a material which can maintain the interior at a constant humidity regardless of outside temperature. Such a material could be conditioned silica gel or certain chemical salts, such as magnesium nitrate hexahydrate or sodium dichromate, and another article will discuss the sealed case from the humidity control viewpoint as well as other factors.

Light is a necessary condition for the display of works of art, but its damaging effects are rarely acknowledged by museums and galleries across the country. Daylight, even through window glass, and fluorescent tubes contain sufficient ultraviolet (high energy) radiation to fade pigments on watercolours and dyes on textiles, yellow paper and weaken natural fibres, especially when combined with high humidities and/or pollution levels in the ambient air. This deteriorative action is related to the ultra-violet content, the intensity and the duration of the illumination, so great care should be taken in choosing and placing lights for displays. Incandescent bulbs and spotlights emit insignificant quantities of ultra-violet light and are to be recommended for sensitive paper and textile works. The major danger from these bulbs is their high output of heat which may be avoided through the use of filters, low wattages, and suitable distance from the object. Fluorescent tubes do emit some ultra-violet, which will cause fading and degrading over a period of time, and these tubes should be covered with special filter sleeves which eliminate harmful radiation, before lighting sensitive works. *No* work of art, aside from stone and metal sculptures, should ever be exposed to direct daylight even behind window glass.

Light levels are important and should be maintained within the generally accepted regions of 50 lux (5 foot-candles) for paper and textiles, and 150 lux (15 foot-candles) for paintings to minimize long term deterioration.

(To be concluded.)

GEORGE deW. ROGERS

Personnel

The Conservators-in-Training programme was launched on 3 June with the arrival of ten trainees who were successful in a competition in which 160 university graduates applied.

Mr. Robert J.W. Arnold and Mr. James K. Purvis are specializing in Fine Art Paintings. Mr. Rodrigue Bédard and Mr. Patrick J. Legris are specializing in Polychrome Sculpture and Decorative Arts. Mr. Michael Gates and Miss Deborah F. Jewett are specializing in Archaeology. Mr. John H.A. Grant and Mr. Thomas G. Stone are specializing in Ethnology. Miss Michèle Marie LaRose and Mr. Glen H. Sisk are specializing in Artistic and Historic Works of Art on Paper.

Apart from developments in the area of training, there have been other staff changes.

Miss Irène L. Richer has joined us as Executive secretary to the Director. Miss Richer has had nine years experience in government service. Mrs. Peggy M. Wynne, Administrative and Research Clerk, has been with C.C.I. since October 1973 but now has a position pertaining to purchase requisitions and budget control. Mr. H.C. von Imhoff has transferred to the Department of Indian and Northern Affairs, National Historic Sites, as Head, Art Conservation section. Mr. S.A. Meese has left to take up a position at the National Gallery of Canada as Conservator of Paintings. Both Mr. von Imhoff and Mr. Meese made a valuable contribution in the formative stages of the C.C.I. training programme.

Dr. Rosamond D. Harley is editor of the Newsletter.

The column Conservation Queries is prepared by Mrs. Rustin Levenson to whom questions should be sent at the
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