Surgical pathology has come a long way since the time that Velpeau, famous professor of clinical surgery at the University of Paris, stated in his work on diseases of the breast published in 1853*: “The intervention of the microscope is not at all necessary to decide whether such and such a tumor, which has been removed, is or is not of cancerous nature.” In the 1870s, Carl Ruge and his associate Johann Veit, of the University of Berlin, introduced the surgical biopsy as an essential diagnostic tool. Despite the controversies that followed, Friedrich von Esmarch, professor of surgery at Kiel and a leading military surgeon, presented forceful arguments at the German Surgical Congress of 1889 on the need to establish a microscopic diagnosis before operating in suspected cases of malignant tumors requiring extensive mutilating procedures. Shortly thereafter, the freezing microtome was introduced, and the frozen section procedure hastened the acceptance of this recommendation. In the United States, the specialty of surgical pathology was conceived and initially developed by surgeons and gynecologists.7,10 It is said that William S. Halsted was the first American surgeon to create a division of surgical pathology at Hopkins when he made Joseph Colt (“Bloody”) Bloodgood the first full-fledged American surgical pathologist. These pioneer efforts, which were initially met with indifference and occasionally scorn by the academic pathology establishment, proved to be hugely successful. In the second phase of its development, the specialty came to be performed by pathology-trained individuals, and this was followed by its logical and perhaps inevitable incorporation into pathology departments. Because of the differences in background, philosophy, and goals between the “surgical” and the “general” pathologists, the merging of the two schools proved to be a slow, complicated, and sometimes frustrating process, and one that is still evolving.

The intellectual, logistic, and financial benefits of this arrangement are, however, too obvious for any alternative scheme to be a realistic consideration.

Of the many individuals who contributed to consolidate the specialty of surgical pathology in the United States during the first half of the twentieth century, special recognition is due to Arthur Purdy Stout of Columbia-Presbyterian Hospital in New York City and his successor Raffaele Lattes; James Ewing and his successor Fred Stewart of Memorial Hospital; Malcolm Dockerty at the Mayo Clinic; and Lauren V. Ackerman of Barnes Hospital. To these, one feels duty-bound to add the names of Pierre Masson in France and Canada, and Rupert A. Willis in Australia and England.6

In terms of publications, the most influential textbooks written during this period in the field of oncologic surgical pathology (subspecialties excluded) were James Ewing’s *Neoplastic Diseases* (1919), Pierre Masson’s *Tumeurs*; *Diagnostic Histologiques* (1923) Arthur Purdy Stout’s *Human Cancer* (1932), Rupert A. Willis’s *Pathology of Tumors* (1948), Lauren V. Ackerman’s *Surgical Pathology* (1953), and the remarkable *Atlas of Tumor Pathology* collection, begun in 1949. The latter work, colloquially known as the A.F.I.P. Fascicles and currently in its fourth series, has perhaps contributed more than any other to establish the discipline of surgical pathology throughout the world as a result of its comprehensiveness coverage, the expertise of the authors, and the substantially low cost of the individual fascicles. Kudos to the Armed Forces Institute of Pathology—an institution currently in dire financial distress—for their mighty contribution to this effort, not to speak of the consultative and other academic activities they have carried out over the best part of the century with such a distinction and generosity.4

**Surgical pathology and the pathologist**

The basic characteristics of the surgical pathologist were masterfully described by the begetter of this book, Dr. Lauren V. Ackerman. Since these remain virtually unchanged 50 years later, it was deemed appropriate to repeat almost verbatim the comments he made in that regard in the early editions of this book:

A department of pathology in a large medical center should have a division of surgical pathology closely
affiliated with the clinical and surgical departments. Surgical pathology implies surgery, but the modern surgical pathologist is closely affiliated with many branches of medicine. This includes all the surgical specialties, internal medicine, dermatology, neurology, diagnostic radiology, radiation therapy, and medical oncology. Although the study of radiology deals with shadows and the study of pathology with substance, the correlation of those shadows with the gross substance strengthens the diagnostic skill of the radiologist, explains errors in radiologic interpretation, and instills humility rather than dogmatism. The radiotherapist and medical oncologist, too, can learn much from the study of surgical pathology, particularly the correlation between sensitivity to therapy and microscopic tumor types and the effects of therapy on normal tissue. Furthermore, explanations for the success or failure of therapy may become apparent by the study of surgical specimens.

The surgical pathologist has the unique opportunity of bridging the gap between the beginning of disease and its end stages, and he should take advantage of this circumstance. He can do this only after a solid foundation of study at the autopsy table, where the ravages of cancer and other diseases are all too clear. With this background, he can then correlate the initial stages of disease seen in specimens from living patients in the surgical pathology laboratory and make fundamental contributions to knowledge. With the integration of clinical findings, pathologic anatomy is still a living science.

By the very nature of the material submitted to him, the surgical pathologist is bound to make some mistakes. He sees the earliest subtle and sometimes bewildering changes in Hodgkin’s lymphoma. He may not recognize that the minimal granulomatous response in a lymph node is really a peripheral manifestation of histoplasmosis. The necessity of follow-up on the patient in whom the diagnosis is not certain is mandatory. Time is often a better diagnostician.

The surgical pathologist not only must know his own field thoroughly, but he also must have a rich background in clinical medicine. He needs to understand the clinician’s needs and respond to them accordingly. He must be in a position to advise the clinician about the biopsy or the excised material he receives. It is not sufficient for him to say whether a lesion is benign or malignant. He must be able to tell the surgeon the extent of the disease, the grade of malignancy, the adequacy of the excision, and other pertinent information. He should also be able to comment on whether additional therapy may be necessary and give information on the prognosis of the disease. He should communicate with clinicians constantly, informally and through interdepartmental conferences. The ever-increasing complexity of medicine has led to the unavoidable development of subspecialization within surgical pathology. There is no question that in some cases clinicians are best served by pathologists who have special expertise in certain areas and fully understand the clinical implications of their pathologic findings. Hematopathology, nephropathology, neuropathology, and dermatopathology are prime examples of such subspecialties.

The exponential growth of knowledge and the incorporation of increasingly sophisticated techniques to the study of pathology makes the need for subspecialization—at least in the academic arena—increasingly apparent. To cite an obvious example, it is hard to believe that the splendid advances made in hematopathology during the past 30 years would have been possible without much concentrated effort on the part of highly specialized individuals.

**Surgical pathology and the nonpathologist**

By its very nature, surgical pathology depends heavily on the input of clinicians and surgeons who are fully aware of the potentials and limitations of the specialty. They should know that a microscopic diagnosis is a subjective evaluation that acquires full meaning only when the pathologist is fully cognizant of the essential clinical data, surgical findings, and type of surgery. The requisition slip for pathologic study should ideally be completed by a physician familiar with the case; too often the task is delegated to a medical student, a nurse, or the surgery resident who was requested to perform the biopsy. One of the most frustrating and potentially dangerous experiences that a pathologist can suffer is that of the occasional requisition form lacking adequate clinical information. I am not referring to a detailed recounting of the symptoms and radiographic findings of the case. I am talking about not mentioning the fact that a patient with a lung nodule had a sarcoma of the thigh removed 3 years ago, or that a “scar tissue” from the face is from the fourth recurrence of a desmoplastic melanoma. The potential medical, financial and legal possible consequences of this negligence are enormous, and there are not enough immunohistochemical stains or computer programs that will fully protect the pathologist and the patient against them. For some subspecialties, inadequacy of clinical information (including the clinical differential diagnosis in a dermatosis), whether because of ignorance or carelessness, is almost an invitation to an inadequate (or at least incomplete) pathologic interpretation.

One of the best ways for a clinician to acquire a feeling of what the specialty is, and how it can be best used, is to have a full-time rotation in surgical pathology during the residency years. We have found this practice invaluable in establishing a mutually beneficial rapport between surgeons and pathologists. The surgeon will certainly
to be routinely reviewed by a second pathologist. The approach is sound but probably not viable on a large scale when considering the substantial additional cost involved.

**Limitations of histologic diagnosis**

It is as important for the surgical pathologist to know the limitations of his specialty as it is for him to be aware of its strength and potential contributions. This fact has been expressed in a most perceptive and amusing way by Dr. Oscar N. Rambo in an article entitled “The limitations of histologic diagnosis.” Excerpts from this essay follow:

Pathologists are physicians and human beings. They have as great a capacity for error and susceptibility to subjective distractions as other practitioners of the art of medicine. Because of certain nineteenth century dogmas and because the teaching of pathology used to be relegated primarily to the long-forgotten pre-clinical phase, pathologists traditionally have been regarded to be more scientific than many of their colleagues. A mystic perversion of this assumption prevails among those clinicians who believe that the pathologist, given only a piece of a patient’s tissue, has all of the other ingredients necessary to produce a statement of absolute truth at the end of his report. More dangerous to mankind is a pathologist with the same concept.

Incomplete communication between the clinician and pathologist may make diagnosis difficult or impossible. To perform intelligently, a consultant must know all the facts that have any bearing on the case. To render a diagnosis from an inherently puzzling bit of tissue with only vague knowledge of its source and no concept of the clinical problem is as fool-hardy as to undertake an appendectomy on his belly.

As an off-duty exercise, pathologists frequently like to play games with slides as “pure unknowns.” Sometimes with their brains and microscopes they can give a remarkably accurate reconstruction of the disease process, pronounce the exact diagnosis and flush with pride at the awed applause of those gathered around the optical altar. And sometimes they can be absolutely wrong. Showmanship has no place in life and death diagnosis.

Much of the effort expended in carefully executing a diagnostic biopsy procedure is wasted if the pathologist is regarded as a technician rather than a consultant. In many instances, the physician who will have to interpret the slide can offer valuable advice about the clinical nature of a lesion and where best to sample it if he [invited] to examine the patient before or during surgery. With historical background, physical findings and precise orientation of anatomic relationships, the [pathologist] can block the tissue in the plane that will give the most meaningful sections.

Most physicians are taught that the best biopsy is a cleanly excised, uncrushed wedge that includes a junction between normal and neoplastic tissue. The edge of an ulcerating squamous carcinoma may be indistinguishable from pseudoepitheliomatous hyperplasia; the junction between colonic mucosa and a well differentiated exophytic carcinoma may be sharp, dramatic and unmistakable, but if the biopsy is inadequate in depth or breadth, the pathologist is obliged to append a note stating that he cannot determine from the tissue submitted whether the process is a cancer or a polyp. The normal margin must not be obtained at the expense of representative tumor. Worst of all are expanding soft tissue neoplasms. Junction biopsies may include only a pseudcapsule that can be hard, typically “fish flesh” and grossly more malignant in character than the tumor beneath. Such a barrier found in the retroperitoneum or deep muscle groups of an extremity may achieve a thickness of one centimeter or more.

While it may not always be technically feasible to obtain bigger, better, or multiple biopsies, there are many occasions in which the advantages of a significant increase in the sample of tumor outweigh the risk to the patient. Adequate volume of tissue permits a choice of fixatives, histochemical studies, bioassay or tissue culture. In some instances, one of the specialized examinations may break a morphologic deadlock.

Before a biopsy specimen is delivered to the laboratory, it may be so damaged that the slides prepared from it are worthless. In place of a diagnosis the pathologist must write, “Tissue unsatisfactory for interpretation.” A more serious consequence of damage is failure to recognize subtle artefactual changes in cells. False positive, false negative and incorrect histogenetic interpretations have resulted from avoidable mishandling of biopsy fragments.

The complaint of withholding information may also be lodged against the pathologist. The unsophisticated recipient of a pathologist’s written consultation will seek out the usually brief, bald diagnostic statement, accept it as the truth and proceed on his definitive therapeutic way. In the majority of instances, the diagnosis is the “truth,” assuming certain minimum standards of professional competence and permitting considerable philosophic license with the word. But the appearance of a sample of tumors and diseases difficult to classify may be thoroughly misleading when considered out of context.

There are ways in which the pathologist can and should indicate doubts and alternative possibilities when he suspects that the tissue submitted to him may tell only part of the story of the patient’s disease or may be a false representation. Retreat to the smug assertion, “I can see only what is in the tissues you gave me,” has been forced on pathologists by colleagues who have sought miracles of extrapolation from inadequate biopsies. Differential diagnoses of tissue have been discouraged by the myth of objectivity; the dogma that pathologists have the final word, and the thundering denunciations of pathologists’ speculations by physicians who want a single, solid answer, right or wrong.

With full knowledge of the relativity of the term, we use [the term] “inexperience” with deliberate intent. Neither pride nor pressure should force a pathologist to make a deci-
Interpreting biopsies is one of the most important duties of the surgical pathologist. In *incisional* biopsies, only a portion of the lesion is sampled, and therefore the procedure is strictly of a diagnostic nature. In *excisional* biopsies, the entire lesion is removed, usually with a rim of normal tissue, and therefore the procedure serves both a diagnostic and a therapeutic function. The decision whether to perform an incisional or an excisional biopsy depends primarily on the size of the lesion; the smaller it is, the more logical it is to take it out completely when first encountered. For large lesions, particularly those of deep soft tissues, an incisional biopsy is usually preferable because of the fact that the type and extent of excision vary considerably depending on the tumor type. The danger of incisional biopsies promoting metastatic spread, a hotly debated subject in the past, has proved to be inconsequential.38

Biopsies are also classified according to the instrument used to obtain them: cold knife, cautery, needle, or endoscope. Of these, the one usually least suitable for microscopic interpretation is that obtained with a cautery, because this instrument chars and distorts the tissue and prevents proper staining.

Some general rules for the biopsy procedure follow. The fact that they are so obvious makes it particularly bothersome that they are so often violated or ignored.

1. The larger the lesion, the more numerous the biopsies that should be taken from it because of the variability in pattern that may exist and the fact that the diagnostic areas may be present only focally.
2. In ulcerated tumors, biopsy of the central ulcerated area may show only necrosis and inflammation. The most informative biopsy is likely to be one taken from the periphery that includes both normal and diseased tissue; however, the biopsy should not be so peripheral that only normal tissue is obtained.
3. The biopsy should be deep enough that the relationship between tumor and stroma can be properly assessed. Epithelia involved by carcinoma have a tendency to detach from the underlying stroma. This should be avoided whenever possible by careful handling of the tissue.
4. Deeply seated lesions are sometimes accompanied by a prominent peripheral tissue reaction, which may be characterized by chronic inflammation, hyperemia, fibrosis, calcification, and metaplastic bone formation. If the biopsy is too peripheral, this may be the only tissue obtained. Similarly, in a mass of lymph nodes, a deep-seated node may show involvement by a malignant tumor, whereas a superficial node may show only nonspecific hyperplasia.
5. When several fragments of tissue are obtained, they should all be sent to the pathology department and all of them submitted for microscopic examination. Sometimes the smaller or grossly less impressive fragment is the only one that contains the diagnostic elements.
6. Crushing or squeezing of the tissue with forceps at the time of performance of the biopsy by the surgeon, at the time of the gross examination by the pathologists, or at the time of embedding by the histotechnologist should be carefully avoided. The artifacts resulting from it often render a biopsy impossible to interpret.
7. Once the biopsy is obtained, it should be placed immediately into a container with an adequate volume of fixative. The temptation on the part of the surgeon or the pathologist to turn it around, wash it, or scrape the surface should be resisted, since it will not provide any information of diagnostic significance but only create artifacts.
8. Depending on the presumed or known nature of the lesion, consideration should be given at the time of the biopsy to the possible need for special studies, such as touch preparations, electron microscopy, cytogenetics, molecular pathology, flow cytometry, or others.
biopsy. He should also be skillful in selecting from the specimen received the portion to be examined microscopically. The cryostat is now routinely used because of the technical excellence of the sections obtained. Freezing the tissue in isopentane (methylbutane) cooled with liquid nitrogen or with an electronic device saves valuable time and results in fewer artifacts than when the tissue is frozen on the cryostat stage. Although all kinds of quick stains have been devised for frozen section use, we prefer hematoxylin–eosin because of the quality of the preparations and the better correlation that this allows with the permanent sections. Technical modification of some special stains such as PAS (30 seconds) and immunostains (7 minutes) have been devised for possible intraoperative use. Examination of cytology specimens obtained by touch preparation of the fresh specimen can add a great deal of information to the frozen sections, and sometimes obviates the need for them altogether (Fig. 1.2).

A most peculiar variation of the frozen section technique is that incorporated in the concept of Mohs’ surgery as applied to skin tumors. In this procedure, the tumor is removed with a scalpel angled 45 degrees to the skin, divided into quadrants, color coded, oriented en face, and sectioned in the cryostat horizontally across the bottom. The slides are then examined “by the Mohs’ surgeon serving as his own pathologist,” the areas of neoplasm are mapped, and immediate re-excision is carried out if indicated. The difficulties of interpreting sections oriented in this fashion are rarely addressed by the proponents of this technique, and the rationale given for “the Mohs’ surgeon serving as his own pathologist” (more often than not lacking any formal pathology

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**Table 1.1 Historical review of frozen-section accuracy**

<table>
<thead>
<tr>
<th>Institution</th>
<th>Year</th>
<th>No. of cases</th>
<th>Overall Accuracy (%)</th>
<th>False positives (%)</th>
<th>False negatives (%)</th>
<th>% Deferred</th>
<th>% Different</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bryan Memorial Hospital (Lincoln, NE)</td>
<td>1938</td>
<td>45</td>
<td>88.9</td>
<td>0</td>
<td>8.9</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>Woman’s Hospital (Detroit)</td>
<td>1957</td>
<td>412</td>
<td>94.9</td>
<td>0</td>
<td>1.4</td>
<td>3.5</td>
<td></td>
</tr>
<tr>
<td>Washington Hospital Center (Washington, DC)</td>
<td>1959</td>
<td>1810</td>
<td>97.6</td>
<td>0.16</td>
<td>1.0</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Barnes Hospital (St. Louis)</td>
<td>1959</td>
<td>1269</td>
<td>98.0</td>
<td>0.30</td>
<td>1.7</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Henry Ford Hospital (Detroit)</td>
<td>1962</td>
<td>1093</td>
<td>97.5</td>
<td>0.64</td>
<td>1.9</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Miami Valley Hospital (Dayton, OH)</td>
<td>1966</td>
<td>1176</td>
<td>98.1</td>
<td>20</td>
<td>1.7</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td>Columbia-Presbyterian (New York City)</td>
<td>1968</td>
<td>3000</td>
<td>97.2</td>
<td>0.27</td>
<td>1.2</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Bispebjerg Hospital (Copenhagen)</td>
<td>1970</td>
<td>1964</td>
<td>96.6</td>
<td>0.60</td>
<td>1.8</td>
<td>0.1</td>
<td>0.9</td>
</tr>
<tr>
<td>Baptist Memorial Hospital (Memphis)</td>
<td>1972</td>
<td>3249</td>
<td>98.9</td>
<td>0.12</td>
<td>0.95</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>University Hospital of San Diego</td>
<td>1973</td>
<td>2665</td>
<td>96.5</td>
<td>0.15</td>
<td>1.61</td>
<td>1.72</td>
<td></td>
</tr>
<tr>
<td>University of Texas and Ohio State</td>
<td>1974</td>
<td>10,000</td>
<td>98.0</td>
<td>0.15</td>
<td>0.88</td>
<td>0.5</td>
<td>0.58*</td>
</tr>
<tr>
<td>University Hospitals (Galveston and Columbus)</td>
<td>1976</td>
<td>3556</td>
<td>98.5</td>
<td>0.17</td>
<td>0.61</td>
<td>0</td>
<td>1.76†</td>
</tr>
<tr>
<td>Bristol Royal Infirmary</td>
<td>1985</td>
<td>1000</td>
<td>96.5</td>
<td>0.40</td>
<td>0.40</td>
<td>5.6</td>
<td>3.5</td>
</tr>
<tr>
<td>Royal Alexandra Hospital for Children (Camperdown, NSW)</td>
<td>1985$</td>
<td>520</td>
<td>90.1</td>
<td>0.40</td>
<td>0.40</td>
<td>5.6</td>
<td>3.5</td>
</tr>
<tr>
<td>Meir General Hospital (Kfar Saba)</td>
<td>1986</td>
<td>586</td>
<td>96.1</td>
<td>0.20</td>
<td>2.5</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>Los Angeles County-University of Southern California Medical Center</td>
<td>1987</td>
<td>1414</td>
<td>94.8</td>
<td>0.40</td>
<td>1.1</td>
<td>3.7</td>
<td></td>
</tr>
<tr>
<td>University of Washington (Seattle)</td>
<td>1989</td>
<td>1000</td>
<td>90.4</td>
<td>0.20</td>
<td>2.3</td>
<td>6.1</td>
<td>1.0</td>
</tr>
</tbody>
</table>


* Grade errors. † No major discrepancy. ‡ Insignificant error (0.9) and significant error (1.3). § Pediatric cases only.
effectiveness.\textsuperscript{77,83,84} Needless to say, the considerable financial forces that exist behind these initiatives (to which pathologists are not immune) are not particularly conducive to an objective and dispassionate evaluation.

\section*{Digital pathology and telepathology}

The era of digital pathology has arrived to surgical pathology.\textsuperscript{91} It has done so mainly through the many anatomic pathology information systems now on the market\textsuperscript{99} and the various devices that exist to capture digital images of gross and microscopic specimens, which can be integrated with the respective pathology reports. This has also allowed for these images to be transmitted electronically to any part of the globe. The latter, in short, is what is meant by telepathology. This can be done at various levels, from the e-mail attachment of a few static photographs to sophisticated systems that duplicate almost to perfection the examination of slides under the microscope and are, therefore, accurately referred to as virtual microscopy.\textsuperscript{97} These instruments

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{fig1_3}
\caption{Metastatic alveolar rhabdomyosarcoma to lungs and pleura in a 14-year-old girl. Electron microscopy of pleural fluid shows well-preserved neoplastic cells containing large quantities of glycogen and lipid; thick and thin microfilaments also may be noted. ($\times$16,850)}
\end{figure}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{fig1_4}
\caption{Immunocytochemical demonstration of HPV infection in a cytologic specimen from uterine cervix. (Courtesy of Dr. Patricia Saigo, New York, NY)}
\end{figure}
most of the routine administrative chores. More sophisticated systems are also now providing storage of both visual and textual information and “expert” consultative support such as on-line assistance with specimen preparation, grading, staging, diagnosis, and bibliographic retrieval.

Regardless of the level of automation chosen, certain features of the system design become very important if the system is to be both effective and acceptable to the user (see box below). The introduction of an automated system into the diagnostic laboratories inevitably causes concern among the staff, whether they are professional, technical, or administrative. Many of the fears that accompany automation are widely recognized because the introduction of computer technology into any work environment significantly redefines “essential” tasks and shifts the balance of authority toward those with computer literacy. Some of these changes are unavoidable and perhaps not altogether undesirable. However, the best systems minimize the level of computer prowess needed to effectively use the system. This is essential at the profession level.

Few pathologists would welcome a system that asked them to alter the way they phrase their reports, and many would resist systems that force them to use the computer to complete their tasks. Therefore, the first and paramount design requirement of any system must be to allow the pathologist to work independently of the computer, if desired, without sacrificing the advantages of the system. This requirement will become less important as familiarity with computers among anatomic pathologists grows; this is already occurring because of the pervasive presence of this technology in everyday life, and it is also facilitated through the incorporation of informatics training in pathology residency programs.

As I am learning the hard way, becoming computer-literate can be a difficult and sometimes painful process for a “senior” pathologist. Yet, I am afraid there is hardly a choice. As Arthur Schlesinger dramatically put in a 1997 issue of Foreign Affairs, “those who skip or flunk the computer will fall into the blade runner proletariat, a snarling, embittered, violent underclass.”

A second feature desirable for effective automation is the rigorous avoidance of redundant data entry. Each data item relating to a case—be it patient name, number of blocks processed, special stains prepared, diagnosis, or billing codes—should ideally involve only a single human intervention. All derivative information, including diagnosis codes, should be automatically assigned by the computer whenever possible. This principle should apply even to the inquiry of patient data, to make it possible to retrieve information on a patient by identifying only a portion of the name or to locate a case by providing only a portion of the diagnostic terms used or any one of an unlimited number of synonyms. A corollary to this requirement is that the system must independently track each data item to allow complete flexibility in the compilation of reports, searches, and inquires using arbitrary formats. It follows that systems that capture data from paper records after case processing has begun (rather than in “real time”) only give the illusion of automation and can offer little or no significant savings in the workload. Similarly, systems that capture most or all of the patient data as text documents in word processing files are highly limited in their reporting and searching capabilities and are also unlikely to eliminate much redundant data entry.

Real-time integration of information from all aspects of the diagnostic pathology operation is also required. For example, specimens for a patient may be simultaneously received in cytology and surgical microscopy, cell makers, flow cytometry, and so on. Information on previous material may also exist. Good practice demands that the information from all current and previous examinations be considered by the pathologist when rendering an opinion. The system must, therefore, automatically bring to the attention of each user information on all previous specimens, as well as information on all current specimens that are being processed, regardless of their stage of completion. Consequently, an adequate pathology information system must be able to simultaneously correlate the input from multiple users, whether they are all working on different aspects of the same case or different specimens for the same patient, and will automatically inform each user of all pertinent information regardless of where or when the information was entered. The practical consequence of this requirement is that (except for the smallest institutions) all users are likely to share a common device (file server) on which the bulk of the relevant data is kept.

A related design requirement is that the system be able to permanently retain on-line all primary information about a case. This includes all demographic and clinical information, the full text of the gross and microscopic description, the full text of the diagnosis and any diagnosis codes, all addenda and special procedures, and all billing and histology laboratory data. Permanent on-line storage of all data is practical and cost effective with current technology and eliminates the need for redundant hard copy storage of patient records if adequate precautions are taken to safeguard the data (see the following

### Basic design criteria for an automated system in surgical pathology

1. Pathologist participation not compulsory
2. Elimination of redundant data entry
3. Real-time integration of all data
4. On-line permanent and safe storage of all primary data
5. Rapid response time
6. Flexible and easily modified design
system for cross reference. It handles all aspects of the preparation of the molecular genetic reports.

**Miscellaneous**

This section contains items such as grading and staging manual for the major tumor types.

**Additional features**

An increasing number of systems currently in use allow for high-quality digital images of gross and microscopic material to be automatically linked to individual cases or teaching collections. These images can also be transmitted to other computers anywhere in the world for diagnostic or teaching purposes (telepathology) (see p. 13).

Reporting by digital speech recognition is already being used at several institutions, at the same time that the speech recognition systems themselves are being developed and perfected. The successful implementation of a “continuous speech recognition” system (i.e., one that does not require a pause between words when dictating) would undoubtedly have a great impact on the practice of anatomic pathology.

### Quality evaluation

The monitoring of the quality of work being carried out in a laboratory of surgical pathology—for the purposes of detecting inadequacies, updating procedures, and improving the final product—is an important responsibility of the laboratory director or his delegate. Traditionally, this has been carried out in an informal and highly personalized fashion. As of late, outside accrediting agencies (notably, in the United States, the Joint Commission on Accreditation of Healthcare Organizations, otherwise known as JCAHO) have mandated a more structured and rigorous system of self-checking, under designations such as quality control, quality assurance, quality improvement, total quality assessment, and the like. Terminological nuances and bureaucratic overtones aside, there is much to be said about a system that will remind people on a regular basis about the performance and documentation of these tasks. Although some general rules apply (Appendix B), the program should be adapted to the idiosyncrasies of the place. A comforting aspect is that most directors will find when setting up the system that in most instances they will be simply identifying and documenting activities that they were already performing. Appendix B is a model for such a program.

### Legal aspects of surgical pathology

The surgical pathologist has not remained immune to the wave of legal actions that has hit the medical profes-

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**Legal aspects of surgical pathology**

The surgical pathologist has not remained immune to the wave of legal actions that has hit the medical profes-
representative of the overall experience) showed that 17% of the total were Pap smear claims (of which 93% involved false negatives). A detailed evaluation of the others revealed some noteworthy facts:

- Four claims resulted from misidentified pathology reports or mislabeled blocks or specimens, resulting in patients being told they had a malignant diagnosis when in fact they did not (and vice-versa).
- Three claims involved a “missed” micrometastasis of breast carcinoma in an axillary lymph node. It was claimed that this error contributed to disease recurrence, which may have been prevented if appropriate chemotherapy had been given.
- Three claims involved a cervical lymph node containing metastatic squamous carcinoma, which was misdiagnosed as a branchial cleft cyst.
- Two claims involved pathologists held liable for diagnostic errors made by the expert consultants to whom they referred the case. This is called vicarious liability, i.e., one can be held responsible for having chosen a negligent consultant.

About half of the claims fell into groups of specimen type or diagnostic category (“systematic errors” or “high-risk” diagnostic areas). They were: breast FNA and biopsy; malignant melanoma; malignant lymphoma, prostatic biopsy, and frozen section; urinary bladder and branchial cleft cyst. The remaining cases were random.

The majority of the claims for breast FNA were for false-negative reports resulting from sampling error. Most claims for breast biopsies concerned the over-diagnosis of ductal carcinoma in situ (CIS) or benign proliferative breast disease as invasive carcinoma, the misdiagnosis of lobular CIS involving ducts as ductal CIS, and the failure to recognize small foci of invasive lobular CIS. Amongst the cutaneous melanocytic lesions, the main problem areas were malignant melanomas misdiagnosed as Spitz nevi, and metastatic melanomas to lymph nodes misinterpreted as malignant lymphomas. Overall, 52% of these claims involved a false-positive diagnosis of cancer.

Epstein has written a very useful and thoughtful article in which he provides good advice to pathologists as to how to avoid the judicial process (and how to behave if unsuccessful in that quest). In it, he mentions that almost 60% of all US-based physicians have been sued at least once, a frightful figure. He adds, however, that only 3% of those cases went to the jury and were decided in favor of the plaintiff, and that about 70 to 80% of medical malpractice cases were disposed with no indemnity payment.

Some very practical points on how to behave in court (beginning with the advice “Dress smartly, but not ostentatiously”) have also been provided by a firm that offers legal training consultancy in the United Kingdom.

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