fee-for-service basis. The more patients a doctor has, the greater his income is. It is financially advantageous to obtain control of some type of service, such as surgery. This enticement has been too strong for some elements in the medical profession to resist. The most outstanding example is the situation that arose between general practitioners who performed surgery and the rest of the profession. These men formed a clique and were instrumental in carrying out certain measures which contributed to the fragmentation of medicine. The most detrimental of these measures was a cut-off in the free flow of training and information in surgery to all practicing physicians who wished it. This was accomplished by creating arbitrary certification requirements which excluded "preceptorship" training (the surgical training of practicing general physicians) and demanded "residence training" (the surgical training of nonpracticing physicians who will limit their practice to surgery). Similar arbitrary prohibitions followed in the other technical specialties of medicine as a direct result of willful prohibitions not necessitated by the nature of medical science per se.

The scientifically oriented physician, as opposed to the technically oriented physician, has suffered a setback. His concern is the investigation of cases. In this he must be free to utilize every technical development available for collecting and handling data. But here he meets with certain obstacles.

The collection of data about a patient involves the use of a great deal of equipment. The more extensive the investigation, the greater the number of technical devices needed. Let us consider the removal of tissue from the body for diagnostic purposes, or x-ray procedures, or the inspection of body orifices and cavities. The physician investigator cannot personally remove tissue from a living patient, because, unless he is a surgical technician, he has not been taught to do so. Adequate instruction in surgical technique has been deleted from medical school curricula and internship training programs. A parallel situation exists in the collection of x-ray data. When inspection of a body cavity is necessary, the situation becomes more complicated: each orifice and cavity lies in the domain of a separate specialist—the bladder, in that of the urologist; the respiratory passages, in that of the thoracic surgeon; the anus, in that of the proctologist.

The storage of data is very important in medicine, since the investigator may come across cases appropriate for a particular study only over a long period. He should have on hand histologic slides of any tissue removed from any patient, plus x-rays and an accurate notation on observations, and these should be observations that he himself has made. Under the present mode of operation, however, the histology slides belong to the pathologist and the x-ray pictures belong to the radiologist, while the records of the physician investigator contain only a verbal description of another physician's observations. The investigator is one step removed from his data.

Since the specialized physician is unfamiliar with the technology of more than a narrow field, he cannot intelligently interpret the raw data yielded by techniques outside his specialty. No one person has, for example, the experience necessary for interpreting such diverse data as histological preparations, x-ray pictures, and evidence of pathological change in a body cavity. We have heard a great deal about an alleged explosion in medical knowledge and its importance in preventing any one man from gaining broad competence. However, it is not an explosion in knowledge but a willful decision on the part of those responsible for medical education that is responsible for the existing limitations in the training and experience of the individual physician.

Revision of the curriculum of the medical school, so that graduates will have broad technical proficiency, as well as academic competence, is long overdue.

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Citations in Secondary Textbooks

Garfield's suggestions regarding citations in popular and interpretive science writing in the periodical literature [*Science* **141**, 392 (2 Aug. 1963)] may be extended to the textbook level. With all of the sciences becoming increasingly complex and the volume of research pouring from the technical journals threatening to engulf us, the role of the textbook writer as a literature abstractor is becoming increasingly important. For a variety of reasons, not the least of which is inadequate preparation of teachers in subject matter, the need for, and value of, citations in textbooks is probably greatest at the secondary level. And yet such texts seldom have adequate documentation. Citations in secondary textbooks to the more important popular articles and original research papers, and even the judicious use of research papers themselves in the class, might produce some startling results. I am convinced that secondary students can be trained to use documentation at a much earlier period than generally supposed.

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Use of Names in Concept Formation

I question the conclusions Ranken has drawn from the experiment on "Language and thinking" [*Science* **141**, 48 (5 July 1963)]. The construction of his experiment almost preordains the outcome. By assigning a different name to each of his eight figures, he tends to create a set in the subject that obscures the similarities of the figures. As a result, those subjects that were asked to form imaginal representations were given an advantage over the others in the jigsaw problem. In addition, Ranken is only assuming that the group that was instructed to form imaginal concepts did, in fact, do so. I feel that a highly verbal person would, in spite of his best intentions, tend to verbalize the shapes.

If a similar experiment were to be performed in which the names recognized the similarities of the shapes, the outcome would be very different. For example, each of the eight shapes is made up of two of four discrete contours. For the purpose of categorizing let us give each of the shapes a pair of names—the first name would indicate the top contour; the last name, the bottom. Even if the subject is not told of the similarities of the shapes, the names will now cue him to recognize these similarities. If he does notice the similarities, the jigsaw problem becomes trivial once the names have been memorized. The subject merely fits the names together as simply as he would fit the actual shapes together.

Of course, the preceding experiment

would go to the opposite extreme from that performed by Ranken; the names become cues, whereas his are masks. The real conclusion to be drawn from Ranken's work is that names can be either a help or a hindrance in concept formation. Names categorize. If the categories implicit in the names have validity for the problem presented, the names will aid in the solution of the problem; if the categories are inappropriate, the names will be a hindrance; if the names are "neutral" (and they rarely are), they will not affect the solution of the problem.

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Baum's main point, that "names can be either a help or a hindrance," seems to be in complete accord with my principal conclusion, that "the effect of prior name learning depends on the nature of the problem" and that names "may facilitate performance in one problem but interfere with performance in another." The next step is to identify the variables which determine whether they help or hinder. The jigsaw and memory tasks were used because they exemplify certain factors believed to be relevant. The results from the jigsaw problem indicate that when the names do not explicitly encode the stimulus properties upon which problem solution depends, names hinder problem solving, other factors being equal.

Baum's suggestion, that giving each shape a different name made it less likely that subjects would notice similarities between top and bottom contours (the only kind of similarity that would be of direct relevance to the jigsaw problem), finds some support in the subjects' responses to the post-experimental question whether they noticed during training "that some of the shapes could be fitted together." Four of the eight subjects in the Unnamed-Jigsaw group reported noticing a total of 17 such pairings, a mean of 2.1 pairings out of a possible 16. Two subjects in the Named-Jigsaw group noticed a total of 6 pairings, a mean of 0.75. This difference does not seem to explain the superior jigsaw performance of the Unnamed group, however. In the first place, the difference between Named and Unnamed conditions in mean error scores (2.3) is greater than the difference in reported pairings (1.35). In the second place, the Named-Unnamed difference in error scores is found both among subjects who reported noticing one or more pairings (3.5 versus 2.8) and among those who reported noticing no pairings at all (5.3 versus 2.5). Noticing the pairings beforehand appears to facilitate jigsaw performance only in the Named condition, where it might be expected to play a more important role if in fact subjects in this condition have less figural information available at the time they solve the problems.

Baum points out that if the names do explicitly encode the stimulus properties which are relevant to the jigsaw problem, they might be expected to facilitate problem solving. I have investigated this variable, using numbers as the "first and last names," and using four-sided shapes in which the names encode only two of the sides (the "selected" contours). The names are learned in a classification task in which the other two sides (the "unselected" contours) are irrelevant. On jigsaw problems involving the selected contours, names facilitate problem solving, as Baum predicts, but only when subjects are explicitly instructed to use the names. In the absence of such instructions, even though the code has previously been explained, subjects with names make as many errors as subjects without names who have had no selection training, and make more errors than subjects who have had comparable selection training by a nonverbal procedure. It is definitely not the case that the subject "fits the names together as simply as he would fit the actual shapes together." Even with instructions to use the names, on problems involving selected, named contours, subjects make two and a half times as many errors (with time held constant) when the problems are given at the symbolic level as when they are given at the concrete level.

On problems involving unselected contours, more errors are made than with selected contours, and subjects with names make more errors than those without names (confirming the previously reported finding). As to the relative importance of facilitating and interfering effects of names in the real world, that will depend, as Baum points out, on the relation between the information encoded in the names and the information required for solving the problem. It will also depend on other factors, such as the extent to which problem solution involves short-term memory. With respect to the information factor, it might be noted that ordinary language coding is typically selective, and that the selected stimulus attributes and relations are necessarily those which are already known to the verbal community. In creative problem solving, which presumably involves responding to attributes and relations which have *not* previously been noticed, the effect of names on availability of information may be primarily negative.

Baum raises the question, which I discussed briefly in my report, whether subjects in the Unnamed conditions may not also have verbalized the shapes. In response to post-experimental questioning, subjects in these conditions reported some degree of verbalization for a mean of 4.4 shapes out of 8. In many of these instances, they reported that they thought of a word occasionally in the early training trials, but that it soon "dropped out." The difference in mean errors in favor of the jigsaw problem over the memory task was greater for subjects below the median, in amount of reported verbalization (1.8 versus 5.2), than for those above the median (3.5 versus 4.0), replicating within the Unnamed condition the interaction between naming and type of problem found in the Named-Unnamed comparison. It appears that the procedures used were effective in producing substantial differences in the extent to which the shapes were verbalized, and that this variable does in fact interact with the type of problem. A more decisive answer to the question of the role of spontaneous verbalization lies in the use of subjects in whom such verbalizations are minimal—young children, mental retardates, and subhuman primates.

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On Traditional and Modern Biology

Eugene Kaellis's philippic against "atomistic prejudice" in biology and his plea for the establishment of a Society of Holistic Biology [*Science* **140**, 1362 (28 June 1963)] reiterates a problem which, freed from its emotional content, remains serious enough to warrant discussion.

The entry in force of the physical sciences and of physical scientists into biology in these decades is a historical fact. Owing to the particular perspectives of the physical sciences, a different character is superimposed upon