received by the interlibrary loan departments of academic libraries in 1970 for all types of publications [table 4.15, (*1*), p. 44]. Requests for periodical materials accounted for about 48 percent of the total, monograph requests were next at 34 percent, 6 percent were thesis and dissertation requests, and 12 percent of the total were classified as other types of publications. Of the estimated 668,000 loan requests for monographs, 3.2 percent were photocopy requests. In other words, about 21,400 loan requests received through the traditional interlibrary loan offices of academic libraries involved photocopying of monograph materials. One can only speculate on the contents actually photocopied. In some cases only the table of contents was requested, sometimes a single page including a table or figure, and at other times a chapter. I doubt that many librarians would allow the photocopying of an entire monograph.

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Curtis Benjamin is about 95 percent wrong in saying that ". . . the most . . . important reason" for less than hoped for sales of science monographs is "widespread and almost uninhibited photocopying . . ." of books by research and special libraries. Science librarians know from personal experience that little or no photocopying of books is done by libraries. Almost all library photocopying is of journals or technical reports, not books. It is my impression that we need not worry about the demise of scientific books until publishers stop looking for authors to write them. I assume this won't happen until scientific book publishing is *really* unprofitable.

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Benjamin has well pointed out the restrictive effect of "soaring" printing costs upon the circulation and even publication of the results of scientific inquiry. This economic effect is compounded when superimposed, as it is, upon the stationary or, in some cases, declining average number of pages in scholarly journals available to a growing number of young scholars. If the dictum "publish or perish" was ever justified, it is growing less so year by year.

The honest facing of this dilemma seems to require immediate and strenuous measures. I propose that the flexibility and low-volume economy of the very photocopying techniques that have caused much of the problem discussed by Benjamin can be brought to bear to solve it. The work of the young scholar, or the innovative ideas of an older one, require the testing of public exposure. Preliminary screening can usually be done among colleagues, but more is needed. An indexed and widely distributed summary of new work, standardized in format, could be made available through libraries. Those attracted by an abstract could order a ful' photocopy of the essay or monograph. Thus, a self-sustaining system could be created for presenting new data, or for gaining critical review of new interpretations.

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I think Kenneth Lowry is at least 65 percent wrong in saying "Almost all library photocopying is of journals or technical reports, not books." This may be true at the Bell Labs library and at a few other strictly research libraries. Certainly it is not true at the several hundred libraries that serve science education as well as research. I know of only one fairly up-to-date source of information on the point: the study by Stuart-Stubbs (*1*) of photocopying practices at 38 Canadian universities in 1971. Stuart-Stubbs found that books and periodicals of all kinds were copied in almost equal proportion. There has been no study in Canada or elsewhere of photocopying at the libraries of 4-year colleges, but spot checks indicate that undergraduates copy books far more frequently than periodicals. My own unscientific but painfully educated guess is that, of all the photocopying done today *at* (not *by*) all college and university libraries, about 65 percent is of books and 35 percent is of periodicals and technical reports.

To Kenneth Lowry and to other doubters, I can only say again that I do not claim to have absolute proof of my thesis. I only know for sure that many large library systems that used to order from two to five copies of a new monograph now order only one copy. I can only deduce that the rapid growth of interlibrary loan services, coupled with readily available copying facilities, has been responsible for this change.

In further support of my view, I can quote a recent *New York Times* report (*2*) on the new research consortium formed by the New York Public Library and the libraries of Columbia, Yale, and Harvard. Based on an interview with the president of the New York Public Library, the report said, "It [the consortium] will enable the libraries to save money by buying only one copy among them, and not four copies, of expensive sets of volumes, for instance, or little-used journals." The report then added that the consortium was to be expanded "as soon as practicable" to include other research libraries.

The report on the four-institution consortium came on the heels of the announcement of a National Science Foundation grant of $368,000 for the establishment at Wellesley College of an academic science information center designed to serve all the Northeastern states. I think it is safe to suppose that the operators of this center will arrange to have one copy of a monograph serve the needs of the whole region.

Yes, the evidence may be presumptive, but to me it is coming through loud and clear.

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2. E. Pace, *New York Times*, 24 March 1974, p. 59, sect. 1, part 2.

Rescheduling for Energy Conservation

There is confusion among policymakers over the proper steps to be taken in the face of the energy crisis. Decisions to rearrange school calendars and work schedules have been made on the basis of intuition, without reference to scientific and engineering principles. We have applied the laws of

heat transfer and have obtained some unanticipated results.

A body loses heat to its surroundings at a rate proportional to their temperature difference. The quantity of heat required to maintain the difference, and therefore the heating fuel costs, is directly proportional to the difference between the indoor and outdoor temperatures. This is the basis of the well-known "degree-day" concept.

Reducing the indoor temperature for a long period of time saves heating fuel because of the direct dependence on the temperature difference; as long as the outdoor temperature does not exceed the indoor temperature, the saving is independent of the outdoor temperature (*1*). Thus, an indoor temperature reduction from 70°F (21.1°C) to a minimum of 55°F (12.8°C) will always accrue the same saving when the outdoor temperature is below 55°F. The most important consequence of this is that arguments based on heating fuel savings which would trade deep winter days for days requiring heating later on are, for all outdoor temperatures below the minimum thermostat settings, wrong (*2*).

Further, two types of fuel saving can be distinguished: those with constant minimum thermostat settings, and those during which higher temperatures are reestablished (warm-ups). Warm-up periods clearly subtract from the reduced-temperature savings, and their number should be minimized (*3*). Thus, as long as the temperatures and total times remain the same, restructuring holiday periods will only result in a net saving of heating fuel if the total number of warm-ups is reduced. Thus, consolidation of holiday periods to reduce the number of warm-ups will effect net heating fuel savings (*4*).

Finally, heating fuel savings will be effected by lowering thermostat settings wherever possible, consistent with human needs and the prevention of damage to physical plant through freezing (*5*). This implies rescheduling holidays to take advantage of safe periods for complete shutdown. Such opportunities for major savings occur in the late fall and early spring in most regions where minimum temperatures above 32°F (0°C) are expected and there is no danger of very low temperatures which would result in freezing conditions in service areas carrying water (*6*). Thus, the greatest heating fuel savings may accrue in facilities which are in continuous operation during the coldest portion of the year (*7*)—when heating to a relatively high temperature is necessary in any case to avoid damage through freezing—and which are completely shut down in fall and spring periods that are very cold, but above freezing.

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References and Notes

1. Heat loss from buildings by infiltration of outside air is also directly proportional to the temperature difference, and can be treated in the same way with the same result; see C. MacPhee, Ed., *Handbook of Fundamentals* (American Society of Heating, Refrigeration and Airconditioning Engineers, New York, 1972), p. 452, table 16.
2. This analysis is invalidated for periods during which the outdoor temperature exceeds the indoor temperature. Trading heated days for days in the later spring when heating plants would normally be shut down will, of course, effect net heating fuel savings. Also, the risks involved in running out of fuel in cool but not cold seasons are considerably lower, and minimizing risk may still call for the exchange indicated if fuel supplies are low enough.
3. Every warm-up period is paired with a cool-down period during which the extra heat stored in the structure and contents reduces the heating requirement as cooling to the new, lower temperature takes place. We have assumed that thermostat settings are reduced so that no further heat is called for until the lower temperature is reached, and that the facility is not in use during the cool-down period. In a zero order approximation, warm-up and cool-down are irrelevant to heating fuel costs.
4. As a specific illustration, distributing the customary 5 days of school spring recess among 5 midwinter weekends serves to create an additional warm-up period. For climates in which heating during the spring holiday period is necessary, this calendar shift will result in a net heating fuel loss.
5. The determining temperature is, of course, that measured in service areas containing water pipes.
6. Building surveys indicate that under some conditions freezing temperatures can be reached in service areas even when working areas are at 55°F (12.8°C). Our treatment ignores heating by sunshine, which may make significant contributions in some areas during the fall and spring.
7. Heating equipment is typically more efficient when run at full load rather than intermittently [C. A. Berg, *Science* **181**, 128 (1973)]
8. We thank H. L. Frisch and R. MacCrone for helpful discussions.

The Density Concept

The article by Day and Day "Cross-national comparison of population density" (14 Sept. 1973, p. 1016) is a commendable challenge to those who oversimply issues of population pressure, but the conclusion that density figures are frequently misleading and often useless has been stated many times before in scholarly work. The authors obviously consulted a variety of