

# IMPORTANCE OF CEMENT MARKET CHARACTERISTICS TO THE INDUSTRIAL GEOLOGIST

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## ABSTRACT

Decisions to develop deposits of calcareous materials for cement production are based largely on anticipated markets for heavy construction which utilizes concrete. The geologist should understand the fundamental factors that underlie such management decisions, so that his field work and reports will more effectively relate to the information requirements of managers in the cement industry.

The paper examines the relationships that exist between exploration and development of calcareous raw materials for cement manufacture and changing factors in the marketing of cement. Continued overcapacity, improved technology, changing distribution patterns, ease of entry, economics of scale, and the nature of product demand are some of the characteristics of the cement industry that are basic to decisions regarding exploration programs and property development.

In the petroleum industry, and to some extent in metal mining, the geologist often reaches important managerial positions in his company. This is not so true in the portland cement industry because the geologist doesn't appear to be able to influence profits very strongly. In this paper an attempt is made to outline some market characteristics that significantly affect earnings of cement-producing companies, and to show how the geologist may contribute in new ways to increasing the profits of his firm and thereby enlarge his managerial opportunities.

The most readily available indicator of economic activity in the United States is the Gross National Product (GNP), data for which are periodically issued by the Department of Commerce. Forecasts of GNP are available from many sources, including the daily press and magazines which print them on a current-value basis. To be more meaningful, a constant-dollar GNP should be used, thereby adjusting for changes in the value of money. Figure 1 shows that deflated GNP has grown in the last decade at about 3 per cent per year, with recent growth somewhat higher, bringing it to an estimated \$623 billion in 1964 (U. S. Council, 1965).

The value of "new construction," about 10 per cent of GNP, is also shown on the chart, because this section of the economy consumes approximately 90 per cent of all cement produced. Recent growth of new construction appears to have been at an annual rate a little above 2 per cent for the decade. Cement production in the contiguous 48 states, the lowest line on the chart, has grown at about the same rate as new construction, but slower than GNP. About 5.25 barrels of cement have been used, per \$1,000 of new construction (constant dollars), for the last 15 years. Note the shift in pattern from the previous decade, when cement shipments rose about 6 per cent per year while new construction rose at a 10-per cent rate and GNP increased about 4.25 per cent per year.

The \$1.1 billion value of U. S. cement production in 1964 is by far the largest component of the \$4.5 billion value of total industrial-mineral production. During the last four years, average national prices for cement have decreased from a 1961 peak of \$3.32 per 376-lb. barrel (U.S.B.M., 1964) to a level that now matches the 1957 price, \$3.18 per barrel, or about \$17 per ton.

## ECONOMIC CHARACTERISTICS

Cement itself has no utility. When combined with water and aggregate, it can be cast as concrete into various shapes. But again, these shapes are undesirable unless they provide something useful, such as a building, a road, a sewer, or even a barbecue pit. These examples show how demand for cement is derived

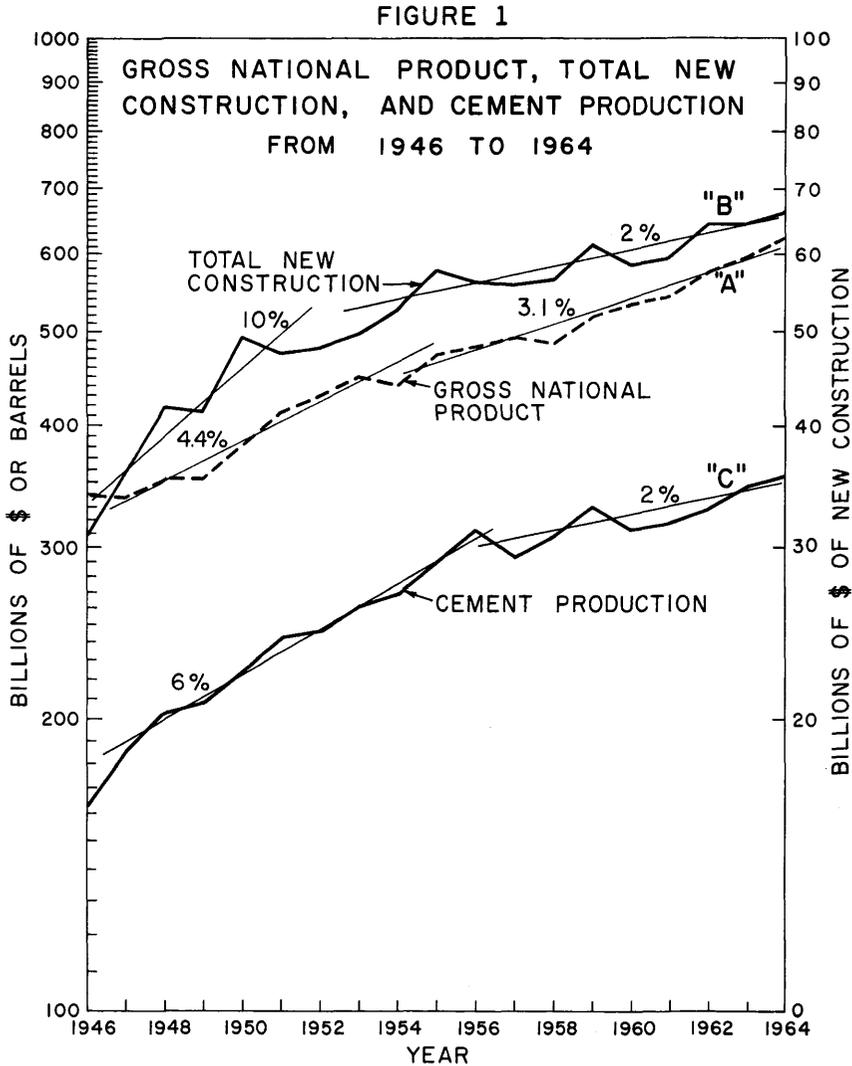


FIGURE 1. Value of GNP and Total New Construction, both in constant 1964 dollars, compared to cement production expressed as millions of barrels.

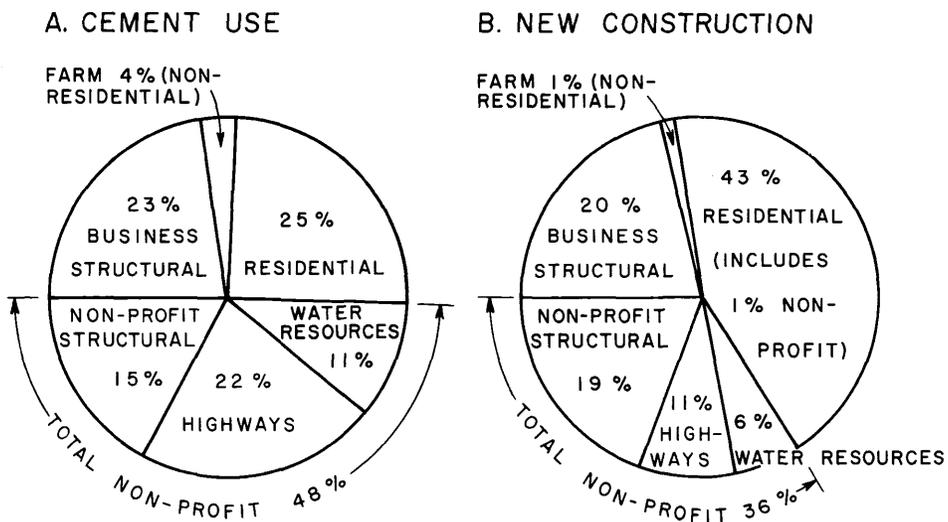
from other needs, though it is generally true that good substitutes are available to meet each need that concrete products fill. In addition, because there is not much difference between the portland cement offered by any of the 50 producing companies in the United States, the product of one may be substituted for the product of another.

The end-use pattern for cement is shown in figure 2 on the left, and on the right are shown the components of new construction, which account for about three-quarters of total construction. The biggest single item in total new construction, residential construction, is 43 per cent of the dollar value of new construction, but only 25 per cent of cement use. Direct government programs, on the other hand, tend to have an impact that is much greater than proportional. For example, every dollar spent on highways means almost four times as much production volume to the cement industry as does a dollar spent on residential housing.

Cement market regions in the past tended to be limited to a radius of 100 to 200 miles from a distribution point (Bell, 1962) for several reasons: the expense of transporting a bulk product like cement, the ready availability of raw materials, the 40- per cent weight loss during calcining, and the uniform characteristics of cement. As a result, in most regions there are only a few manufacturers of cement, but there are many buyers, a condition referred to by economists as oligopolistic. Selling prices tend to be identical because even the smallest price difference between competitors producing an undifferentiated product such as cement will cause buyers to shift to the lowest-priced source of supply.

Identical prices lead buyers to split their business among sellers, because it costs nothing to gain the advantage of multiple sources. In an attempt to build consumer loyalty, and because price competition is known to hurt all producers,

FIGURE 2



"NON-PROFIT" REPRESENTS PRIMARILY PUBLIC BODIES BUT INCLUDES PRIVATE, NON-PROFIT ACTIVITIES.

SOURCES: A. COMPOSITE ANALYSIS OF SURVEYS PUBLISHED BY VARIOUS TRADE ORGANIZATIONS.

B. U.S. DEPT OF COMM., BUR OF CENSUS, CONSTRUCTION REPORTS

FIGURE 2. Comparison of the components of Cement Use and New Construction Expenditures.

competition tends to occur on items other than price, for example: marketing services, immediate delivery, help in financing, and reputed higher quality. The one time that rapid price erosion appears is when a new competitor tries to achieve volume sales quickly by price-cutting. Soon the market stabilizes at this new lower price unless additional cuts are made. On the other hand, price increases are difficult to make, for there is no assurance that all producers will follow a price rise. This is the reason that cement-price rises are announced far in advance; if competitors do not match the rise, then the price leader may rescind the increase without having lost business (Tompkins, 1956).

The level of cement consumption is not affected in the short run by regional increases or decreases in price. This condition, referred to as inelastic demand,

occurs because cement cost represents only a small portion of the final cost of any construction job. In the long run, because of availability of substitutes such as asphalt, demand is price-elastic, that is, upward changes in price can cause a greater than proportional drop in demand because consumers will substitute other materials. Therefore, the cement industry cannot increase profit by lowering the price, while, conversely, price increases may cause a gradual shift to competitive products.

The focus of this paper is on market characteristics such as price and demand; little will be said about the production of cement other than to point out that, about 1960, there was a dramatic upward shift in the size of new cement plants. Dundee (Michigan), Atlantic (New York), and the newly announced Dundee (Missouri) cement plants are all several times larger than those which were considered optimal size for over a generation (Loescher, 1959). Only 18 plants, with a capacity of above 4 million tons, existed prior to 1960; except for those in one or two special areas, these pre-1960 plants probably did not achieve costs significantly lower than efficiently run smaller plants.

Modern economies in operation and transportation permit a vastly enlarged market area. Dundee reaches into Chicago from East Michigan, Atlantic sells all along the length of the eastern seaboard, and presumably Dundee's future Missouri plant will be able to sell throughout the central United States from New Orleans north to Minnesota, Wisconsin, and Chicago, east to Cincinnati, and west to Omaha. Bahama Cement, a subsidiary of U. S. Steel, plans to sell internationally from the middle Atlantic States to the Gulf ports and Caribbean islands (Trauffer, 1965). This vast expansion in the market areas for well-located plants constitutes a revolution in cement marketing.

#### MARKET CHARACTERISTICS

For years the cement industry was characterized by little emphasis on sales, and the producing companies tended to be simply order-takers. This attitude may have been partly due to the "friendly" nature of competition between producers, a common result of oligopoly. The primary attention given by cement firms to production activities has only recently begun to change, as a result of persistent overcapacity and competition resulting from new sellers' attempts to enter territory in which they previously did not serve.

Improvements in quality and uniformity above minimum acceptable standards are one manifestation of non-price competition. More significant has been the trend toward maintaining many local bulk-distribution points, in order to provide prompt, almost immediate delivery to customers. This change alone is estimated to have cost the industry well over \$100,000,000 (Trauffer, 1963). Multiple distribution points are an added and expensive service that most companies have adopted only for defensive reasons. Competition has prevented an offsetting price rise to compensate for the increased costs of these distribution terminals (Bell, 1962).

Bulk delivery now accounts for about seven-eighths of all cement shipped, a rapid rise from the two-thirds of a decade ago (U. S. Bureau of Mines, 1964). In the same period, the proportion delivered by truck has dramatically shifted from one-third to two-thirds, while the fraction transported by rail dropped from two-thirds to one-third. Water transportation, which is primarily intra-company in nature, has made possible much of the changing marketing pattern for cement. Unfortunately, available statistics, which are based on type of carrier used to move cement to the consumer, do not permit analysis of the trend to water transport of intra-company shipments. It is safe to say, however, that water movement of cement accounts for a significant and increasing share of the total ton-miles involved in cement transport. A waterways user tax, which is now being considered by the Federal Government, would certainly change some of the present economics of inland-waterways transportation.

Imports have never seriously affected the United States market, and it is only a few select areas on the periphery of the country, such as Connecticut and Rochester, New York, that have been subject to major inroads by imported cement. But this year an overseas plant, Bahama Cement, will ship to the United States from the first offshore operation designed with this market as its principal outlet.

In addition to these changes within the cement industry itself, it has become popular in the last half dozen years for big ready-mix concrete firms to produce cement, also. Such a captive plant can be operated close to capacity by large concrete producers, thereby achieving startlingly low average-unit costs. While it is true that only a few concrete producers are large enough to justify such a move now, this situation could change quickly with either a technological breakthrough permitting competitive small-scale cement plants or an acceleration of mergers in the concrete industry resulting in many more large-size concrete-producing companies.

#### SHIFTING RESOURCES

Much has been said by the industry's press and leaders about over-capacity. The problem is dramatic when one looks at the logarithmic graph of production versus capacity (Figure 3) and observes that the 480-million-barrel capacity is 25 per cent above the 1964 production of 360 million barrels. The major reason for such rapid building is the relatively attractive after-tax profit margins, which averaged above 15 per cent for well over a decade, and still exceed those in many other industrial sectors. An examination of Figure 4 indicates that "earnings on net assets" in cement manufacturing, a low-risk business, has been favorable when compared to earnings in metal mining, and iron and steel, and has been within the range for all manufacturing.

The cement industry is relatively simple for a new producer to enter, because the technology is easy to acquire (Conway, 1965) and the costs of a new plant (about \$5 to \$10 per barrel of annual capacity (Hiltman, 1960)), are not prohibitive in this day of giant corporations. We predict that overcapacity can be expected to continue as long as relatively high profit margins are available to cement producers, or until further technological advances upset present locational patterns.

Overbuilding of capacity originally began in the mid-1950's, when there were many regional shortages due to heavy post-Korea demands and imbalances in the location of cement capacity. As a result, construction backlogs grew, despite the delivery of high-priced cement from distant points. At the same time, a shortage of steel for construction was increasing builders' interest in concrete. In 1956, the combination of these fortuitous circumstances, which had pushed production up at a rate of 6 per cent per year, suddenly evaporated and, with the return to more normal economic conditions, growth in demand for cement dropped back to about 2 per cent per year. Despite these changed conditions, capacity continues to grow at 4 per cent per year (figure 3).

Because local demand for cement is volatile, a capacity buffer is needed to assure adequate supplies for the national market at all times. In the early 1950's, a buffer of about 15 per cent excess capacity apparently was required to prevent regional shortages in peak seasons, but improvements in transportation and construction techniques, as well as a better geographic distribution of plants, probably means a 10 per cent national buffer is now adequate. With a 480-million-barrel capacity, the United States consumed only 360 million barrels in 1964; of the 120 million barrels of excess capacity, only 40 million barrels are needed to provide the buffer required today.

There are three basic alternative solutions to the problems we have mentioned: to stand "pat," to shift production to better locations, to shift resources out of the cement industry, or some combination of the latter two. If the decision is

to shift to better locations, many different variables will have to be considered, the primary one being estimation of the potential consumption of the product and the transportation advantages of the new plant. Alpha Cement has just made such a move, closing a Pennsylvania operation and rebuilding one on the Hudson River (Trauffer, 1965). Kaiser Cement obtained part ownership of a cement

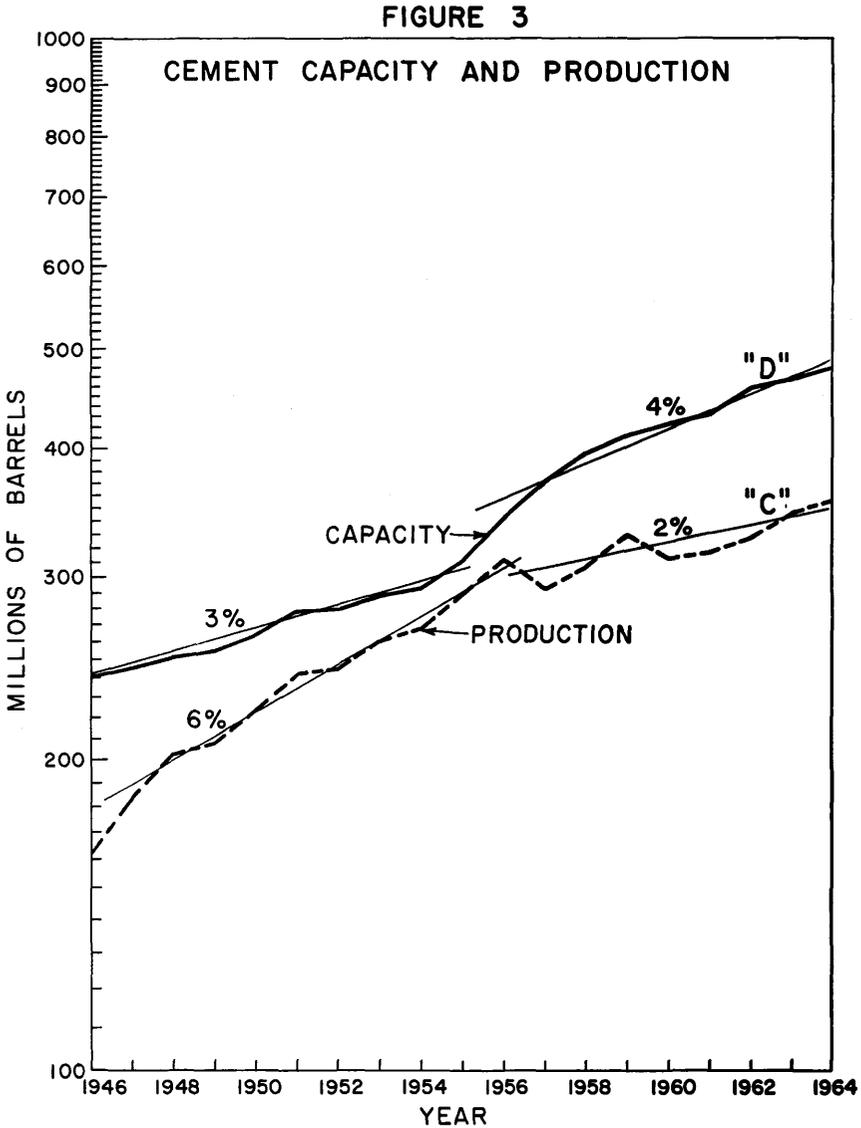


FIGURE 3. Cement Capacity and Cement Production from 1946-1964.

company in Okinawa in 1964 (Trauffer, 1965) and another United States firm is considering building a plant in Greece.

If the decision is to shift resources into production of other products, consideration should be given to diversification of use of current human talents of the corporation as well as its material assets. For example, Lehigh Cement is pro-

ducing lightweight aggregate in rotary kilns. The material is produced in old cement kilns from raw materials similar to those used in cement manufacture and is sold to the construction trade. Thus the firm's new product utilizes the knowledge that salesmen, operators, engineers, and geologists have already acquired in the cement industry.

A different type of solution to the problem of shifting resources is provided by firms which are moving into the production of concrete, thereby providing a captive outlet for cement. In cases where this forward integration is by merger with existing concrete producers, it is being challenged by the Federal Trade Commission. Some firms, notably Lone Star, have acquired aggregate producers, probably as a preliminary step to establishing their own concrete production facilities, a maneuver the F.T.C. may permit (Anon., 1965).

FIGURE 4

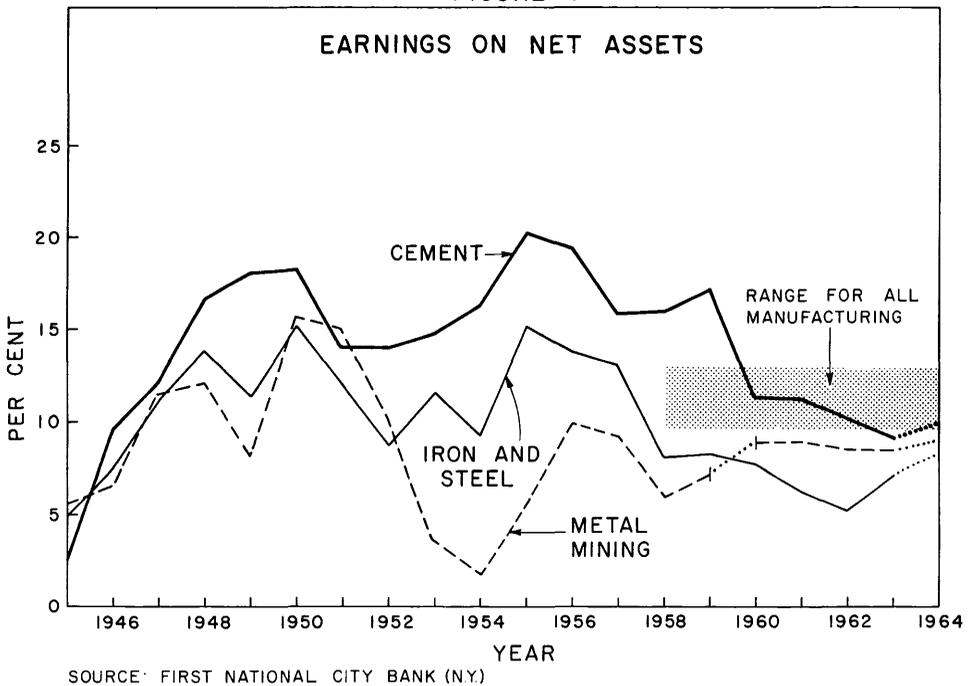


FIGURE 4. After-tax profit margins in selected industries.

The portland cement industry is in ferment; the time is ripe for innovators, whether their functional specialty is accounting, geology, or some other field. What is required of them is an understanding that the cement industry exists solely to meet the consumers' needs for construction, and an ability to synthesize new methods for using the firm's capabilities to meet such consumer needs.

PLACE OF THE GEOLOGIST IN THE CEMENT INDUSTRY

The geologist was not important in the cement industry until after World War II. Since that time, most of his work has been confined to routine geological activities, such as mapping, estimation of reserves, and tactical decision-making, such as the selection of sampling methods or determination of suitable raw-material blends (Weaver, 1965). The scope of this work has extended from the quarry to the production processes and has traditionally led to a concern with tactical

problems only; it has not required an awareness or concern about strategic problems. Knowledge of the aims and ambitions of company policies, as well as a realistic picture of the cement industry as a whole, are vital if the geologist wishes to contribute to the planning of long-term strategy and thereby become an important part of the management team.

The training of geologists is often one-sided in its emphasis on science, while ignoring the commercial aspects of mineral utilization. Too many geologists leave school without having had contact with anything so "practical" as a basic course in economics. This is not to say the geologist should be a trained economist or businessman, but he should at least be aware of how the world of dollars and cents functions. Once in industry, the geologist should become concerned with the over-all picture of how his company and the industry operates.

Factors such as possible vertical integration, economies of scale, and new technological developments, can make significant changes in the prospects of success for certain deposits. Expansion into the production of aggregate, concrete, or concrete products may be feasible at some locations, but not at others. Transportation advantages, such as a site on a large navigable river or along a seacoast, perhaps outside the United States, may provide a competitive advantage for a new plant. Technological changes can work in any direction, possibly leading to lower costs for smaller plants through new types of kilns, or lower costs in larger plants with improvements in raw-material beneficiation and electronic process-control devices. The geologist's specialized knowledge prepares him for an innovator's role in seeking out opportunities for his company to make use of the above factors, each of which has a bearing on the value of a deposit.

An awareness of locational advantages of one deposit over another, based on a knowledge of available markets and transportation methods, will naturally lead to the consideration of only those deposits and developments which are better business ventures. This reduces the time and money necessary in considering possible alternatives, eliminating those ventures which might be excellent geologic possibilities, but which are marginal or unprofitable economically.

An evaluation of sand and gravel deposits or associated clay or shale formations near a proposed cement plant site, which could be exploited as raw material for additional products, might enhance the value of a particular property, thereby making it more desirable than an alternative site where there are no possibilities for joint production. A suitable deposit of limestone, coupled with nearby sources of good aggregate close to a market for concrete and concrete products such as block and pipe, would be a far superior development possibility than would a deposit of somewhat higher-quality limestone without nearby aggregate sources. In addition, the presence of an aggregate or agstone (agriculture stone) market nearby would be another incentive for the production of crushed limestone, either as a by-product or co-product. Unfortunately, variation in depletion allowances for kiln feed versus crushed stone discourages cement firms from production of aggregate.

Since technological changes in the cement industry can have drastic effects on all phases of the business, an awareness of the technology and new developments in the industry allows the geologist to adjust his procedures and evaluations to cope with or implement these changes. The geologist who keeps a file of limestone deposits suitable for use in the event of new technological developments, as well as deposits suitable in light of existing methods, is placing his company at a definite strategic advantage. A file of potentially commercial deposits, cross-referenced with the technological developments that could make them profitable ventures, permits rapid action when a breakthrough is made. An example of this would be a dossier on small deposits near major markets that would be economic if small, efficient kilns were developed.

The list of possible innovations that the geologist may wish to recommend

for any particular deposit that might result in selecting a better investment alternative is not exhausted. Additional innovations are better known to geologists in the industry than to mineral economists on the outside. Company geologists are urged to make every effort to see that the decision-makers in their companies are aware of possible raw material and locational innovations and understand how these innovations could increase the profits of the company.

The geologist can be more creative within industry by drawing together a mixture of ideas garnered from different fields of knowledge (Simon, 1964). In order to gain or maintain a broad knowledge of his firm, the geologists should establish good contacts with personnel in other activities within his company. For example, a periodic luncheon with the sales manager and the traffic manager may yield valuable information which could be used in later recommendations in geologic reports. Reading trade journals such as *Pit and Quarry* or *Rock Products* may provide a clue on new technology that will make possible the development of previously ignored deposits.

#### SUMMARY

There are many paths open to the cement industry in the future. Among the possibilities that would most drastically affect the development of new deposits are:

1. A trend toward the utilization of smaller deposits and smaller plants located closer to major market areas. This would depend on development of small, efficient kilns.
2. Exploitation of foreign deposits, with the United States market as the principal consumer. This could have a drastic effect on the development of deposits along the periphery of the United States.
3. Changing economies in transportation, such as the proposed tax on the use of inland waterways, which could soon change the optimum strategic location of large cement plants.
4. Continued overdevelopment of deposits and capacity until the profit margin in the production of cement is reduced to the point where other ventures appear more profitable.

The above are potential developments with which the geologist should be familiar, for he is in an excellent position to make various locational, technological, by-product, and co-product recommendations, based on a combined knowledge of geological information, company goals, and market characteristics of the industry.

In conclusion, geologists are urged to maintain an understanding of the non-geologic aspects of their company's business so they will be in a better position to advise on investment decisions. In this manner, they can and should become an important part of the top management effort of guiding and directing the long-term development of their companies and of the cement industry.

#### REFERENCES

- Anonymous.** 1965. Lone Star Cement Buys Stone Facilities. *Wall Street Journal* 165(4): 8.
- Bell, J. N.** 1962. Revolution in Cement Distribution. *Rock Products* 65(5): 105-109.
- Conway, W. J.** 1965. Cement Industry. *Mining Congress Journal* 51(2): 110-112.
- Hiltman, J.** 1960. Prescription for Economy. *Rock Products* 63(5): 99-103.
- Loescher, S. M.** 1959. Imperfect Collusion in the Cement Industry. Harvard University Press, Cambridge. 331 pp.
- Simon, H. A.** 1964. Understanding Creativity. *Carnegie Review* (2): 2-9.
- Tompkins, J. S.** 1956. Crack in Cement. *Barron's* 36(13): 9.
- Trauffer, W. E.** 1963. Cement. *Pit and Quarry* 55(7): 94-108.
- Trauffer, W. E.** 1965. Cement. *Pit and Quarry* 57(7): 84-97.
- U. S. Bureau of Mines.** Minerals Yearbook. U. S. Government Printing Office, Washington: Issued annually, chapters cement.
- U. S. Council of Economic Advisers.** 1965. Economic Report of the President. U. S. Government Printing Office. Washington: 290 pp.
- Weaver, K. N.** 1965. Geologist's Role in America's Cement Industry. *Mining Engineering* 17(1): 51-54.