Project B-226

# ANTIBIOTICS:
# A MANUFACTURING OPPORTUNITY IN ATLANTA

Prepared for

FORWARD ATLANTA
The Atlanta Chamber of Commerce

by

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## Foreword

Continuing change in key factors important to industrial plant location requires periodic review of established location patterns. This analysis focuses on factors which should make Atlanta an attractive location for new antibiotics plants.

Decentralization of the industry appears to be a logical move to take advantage of a combination of significant factors affecting antibiotics manufacture. The opportunity to serve a regional market profitably from Atlanta is one such factor. More important, however, are the opportunities and economies to be found in the unusual combination of attractions which exist in Atlanta.

This report is the fourth in the series of special technical reports on manufacturing opportunities in Atlanta. Comments, questions and confidential requests for additional information are invited.

Kenneth C. Wagner, Head
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## Summary

The tonnage of antibiotics sold increased almost 170 per cent between 1951 and 1960. In 1958 manufacturers' sales were $431 million nationally and should reach $750 million in 1968.

There will definitely be a considerable need for additional facilities at the rate the industry is expanding. Although there has been no tendency toward decentralization as yet, there would be a number of advantages to putting a plant in the Atlanta area:

1. Significantly higher production could be expected per dollar of wages paid, providing a substantial increase in net operating profits.

2. An excellent water supply is available from the Chattahoochee River, where the water temperature is sufficiently low to be used for cooling purposes in the production process.

3. Better waste disposal facilities are available than in most other sections of the country.

4. The plant would be located at a major transportation-distribution point.

Since Atlanta is a research center, a sizable number of scientists, engineers, and technicians are available at the educational, industrial and governmental research facilities in the area.

These assets should place an Atlanta area plant at a distinct competitive advantage over plants in other sections of the country.

A "bonus" exists in the size of the local and regional market. Since antibiotics manufacturing has not been market oriented, plants have not been constructed to serve regional markets. However, a market near a plant is always an asset and more drugs are wholesaled in Atlanta ($233 million in 1958) than in any one of 41 states. New York, Chicago, and Los Angeles are the only cities with higher sales. In view of the exceptionally rapid expansion of the consumption of antibiotics, it is easy to imagine the South consuming the entire output of a new plant.

# INTRODUCTION

This report is intended primarily for those companies already manufacturing antibiotics and is designed to show them the opportunities which exist to make profits by means of locating new manufacturing plants in the Atlanta area.

The antibiotics industry has been characterized by very rapid expansion and many new plants will be needed to supply the future demand. This report points out the advantages Atlanta offers as a site for the new plants which will be needed to meet expanding markets.

For those readers not familiar with the industry, a brief description of the background for this report follows.

## The Production Process

Most antibiotics are produced basically through the controlled growth and multiplication of selected strains of microorganisms. The particular strains of microorganism selected for the production of antibiotics are those which will inhibit the growth of or destroy other microorganisms which cause diseases in humans and animals. Commercial production of most antibiotics is accomplished through the controlled growth of certain microorganisms using a fermentation process.

There are certain primary considerations involved in selecting a location for an antibiotics plant. Each is discussed briefly below.

## Availability of a Large Water Supply

Water is used both in the processing broth and for cooling purposes during the fermentation process. It has been estimated that enough water is used daily by one antibiotics plant to supply 100,000 people.

## Waste Disposal Facilities

The thousands of gallons of broth from which the antibiotics are recovered create a waste disposal problem. The broth contains mycelia, remnants of the nutrients used, and small quantities of the antibiotics. The volume of waste broth is too great for most sewage systems. It is therefore desirable to locate a plant near an ocean or a very large river where the pumping of the waste into these waters is allowable. Otherwise, a large area of land is required for burial of the waste matter.

Availability of Land

If disposal of waste into a large body of water is impossible, the burial method of disposal must be used. This method requires a large area of land adjacent to the plant site. Therefore, a plant which utilizes this method of disposal needs to be located in an area where sufficient land is available at a reasonably low price.

Cost of Labor

Price competition among the major producers, plus the requirement of increased expenditures for sales promotion and research as a per cent of net sales,[1/] have caused the major manufacturers in the industry to become more concerned with the controllable costs of production -- particularly labor costs. Labor rates vary significantly in different sections of the country and are a primary consideration in selecting a geographical area in which to construct a new plant.

Access to a "Research Community"

Since a manufacturer's sales position in the industry to a large extent depends on the development of new products through research, the company would find it advantageous to have its operations located in or near a research community. The producer would thus have access to research personnel required for a product development program.

Competition is pronounced among the producers in the research and development of new products. A manufacturer who attempts to produce an "unchanged" product in this industry would quickly experience a sharp drop in sales. Appendix 1 indicates the change in volume of sales of individual products.

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1/ Selling and advertising expenditures increased from 12.9 per cent of net sales in 1950 to 24.0 per cent in 1958. Research expenditures increased from 4.4 per cent in 1950 to 6.4 per cent in 1958. Ibid., and Administered Prices, hearings before the Subcommittee on Antitrust and Monopoly of the Committee on the Judiciary, United States Senate, Eighty-Sixth Congress, Second Session, pursuant to S. Res. 57, U. S. Government Printing Office, Washington, D. C., 1960.

## Centralization of the Industry

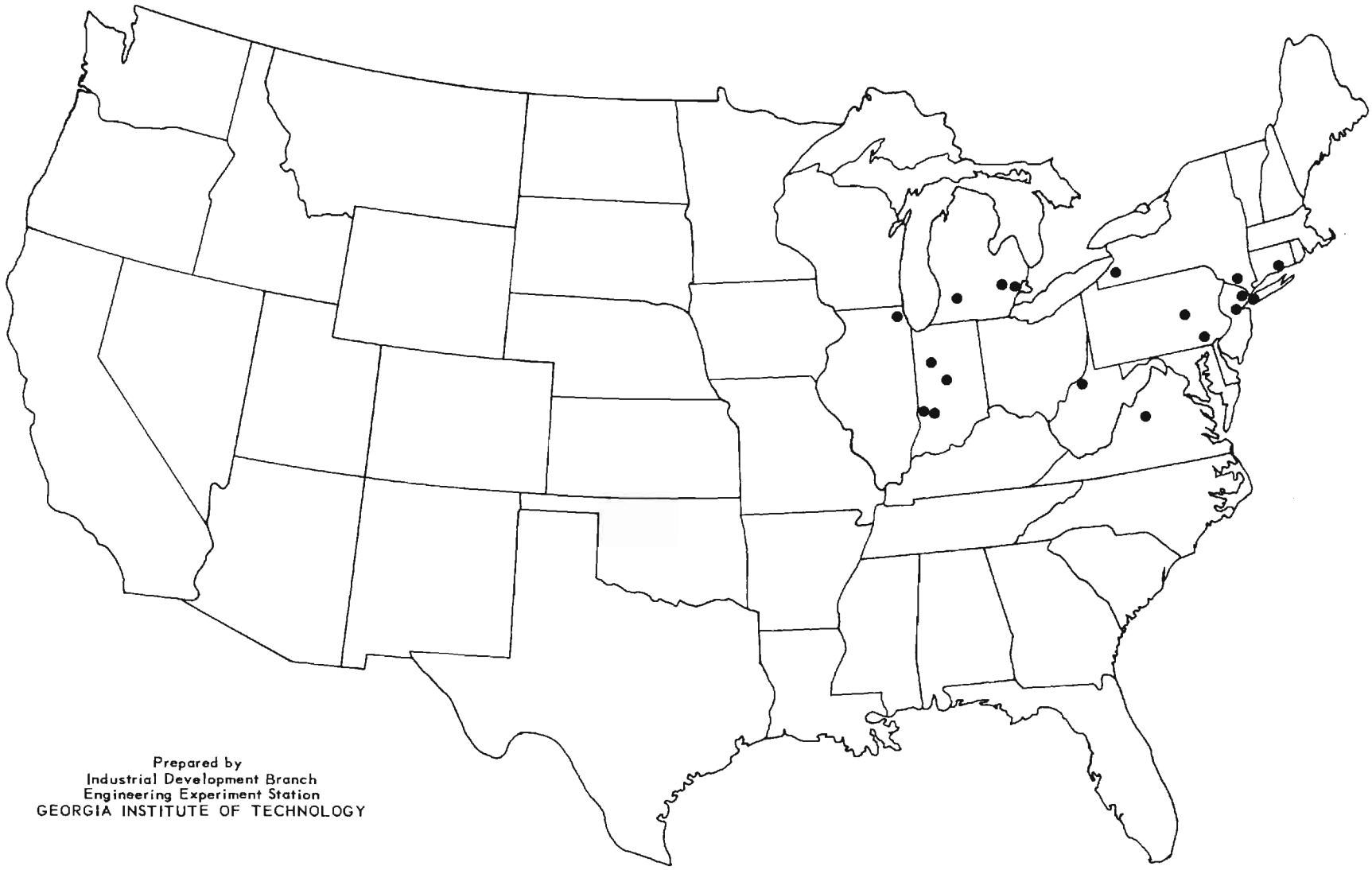
Products in this industry in almost all instances have a high manufacturer's value per pound. Therefore, the cost of shipping drugs either in bulk or packaged form from the manufacturer to the buyer is negligible. Also, the production of antibiotics involves complicated chemical processes which in turn necessitate a high investment in plant and equipment. The production process must be carried out on a large scale to be economically feasible.

Because of these conditions the firms in this industry have shown little tendency to decentralize their antibiotic operations. Each manufacturer sells to a national market. Figure 1 indicates the location of manufacturers of antibiotics.

Antibiotics are generally distributed through wholesalers and retailers to the final consumers. They are never sold directly to the ultimate consumer by the manufacturer. Appendix 3 indicates the various channels through which the items are marketed.

Because of the fact that the ultimate consumer does not choose the particular antibiotic he uses, advertising and other promotional efforts of the manufacturers are directed toward physicians and veterinarians who prescribe the particular drug used by the consumers.

FIGURE 1
LOCATION OF ANTIBIOTICS MANUFACTURING PLANTS



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## THE NEED FOR NEW PLANTS

### Market Growth

In just two years, between 1956 and 1958, the dollar volume of sales of antibiotics rose 27.6 per cent, to $431 million. Table 1 indicates that tonnage of antibiotics sales increased almost 170 per cent from 1951 through 1960. This growth trend is expected to continue throughout the 1960's. Sales of all antibiotics should increase to $750 million annually by 1968.

The rapid increase in sales will engender the need for new plants to meet the demand. Although there is at present no shortage of capacity, the 75 per cent increase in sales forecast in six years will utilize present capacity and more.

### Location Factors

A plant to make antibiotics requires a location with the following special characteristics (see Introduction):

1. large supplies of cooling water,
2. high capacity waste disposal facilities,
3. large land areas, and
4. availability of trained research personnel.

If in addition, the company can find an area where cost savings can be obtained, such an area would be an excellent location -- especially if a volume market exists there as well.

The cost of goods sold in the entire antibiotics manufacturing industry in 1958 averaged 32.3 per cent of net sales. Selling and advertising expenditures accounted for 24.0 per cent of the sales, while research costs accounted for 6.4 per cent of the total. Net operating profit after taxes amounted to 13.1 per cent of net sales for the industry, while general and administrative expenses amounted to 11.2 per cent of sales.

Although manufacturers' expenditures on research and sales promotion will undoubtedly have to remain as high or higher than the above figures in order to compete effectively, labor costs per unit output can be reduced when new plants are constructed, both by building more efficient plants and by locating the new facilities in geographical areas where wages represent a smaller percentage of the value of output.

Table 1

Sales of Antibiotics by U. S. Manufacturers, 1951-1960
(in thousands of pounds)

| For Human & Veterinary Use: | 1951 | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 | 1960 |
|---|---|---|---|---|---|---|---|---|---|---|
| Bacitracin | - | - | 4 | 5 | - | - | 6 | 6 | 6 | 5 |
| Dihydrostreptomycin | 264 | 301 | 297 | 286 | 332 | 431 | 462 | 465 | 492 | 363 |
| Neomycin, base | - | - | - | 9 | 11 | 14 | 19 | 24 | 28 | 30 |
| Penicillin (Potassium) | 120 | 147 | 144 | 113 | 112 | 137 | 133 | 134 | 160 | 196 |
| Penicillin (Procaine) | 340 | 390 | 509 | 258 | 259 | 343 | 344 | 284 | 268 | 417 |
| Penicillin (All other) | 27 | 51 | 55 | 56 | 74 | 113 | 124 | 73 | 61 | 64 |
| Streptomycin | 36 | 41 | 104 | 75 | 99 | 147 | 169 | 166 | 240 | 329 |
| Tetracycline | - | - | - | - | - | 186 | 299 | 243 | 257 | 256 |
| All other | 268 | 391 | 354 | 461 | 480 | 366 | 430 | 487 | 530 | 668 |
| For Animal Feed Supplements, Food Preservation, and Crop Spraying: | | | | | | | | | | |
| Total | 196 | 172 | 391 | 562 | 553 | 683 | 795 | 1053 | 1108 | 1126 |
| Grand Total | 1251 | 1493 | 1858 | 1825 | 1920 | 2420 | 2781 | 2935 | 3150 | 3454 |

SOURCE: U. S. Tariff Commission, Synthetic Organic Chemicals, U. S. Government Printing Office

Therefore, a location for an antibiotics plant is one which includes the four characteristics listed on page 5, has a low wage input per unit of product and offers a large market.

## ATLANTA AS A LOCATION

Although drug manufacturers distribute world-wide from a single plant and the location of the market is therefore not critical in plant location, a big market near the plant is nevertheless, always an advantage.

### Market

Metropolitan Atlanta is one of the largest market areas in the country for drugs; $233 million worth were sold wholesale in the city in 1958. The entire New England area in the same year wholesaled only $246.9 million, while the states of Florida, North Carolina, and South Carolina combined wholesaled only $234.9 million. Excluding Georgia, only eight states wholesale more drugs than metropolitan Atlanta alone. To put it another way, 41 states wholesale less drugs than Atlanta. Of all cities in the United States only New York, Chicago, and Los Angeles had higher sales.

From these comparisons it is obvious that Atlanta represents a huge market for all drugs. The market for antibiotics in the area would be in proportion to the market for all drug products.

In addition to itself being a huge, highly concentrated market, Atlanta can offer a manufacturer advantages in critical cost areas, as well as services comparable with those in the largest metropolitan areas. Probably the most significant of these advantages is that of substantially lower labor costs. Other advantages include a large source of adequate cooling water, waste disposal facilities, available land for plant sites, location near a major distribution point, and independent research capability in the area.

### Labor Savings

Georgia production wage rates in the drug industry, as in many other industries, are significantly lower than the national average. The rate applicable to the manufacture of antibiotics is that for the Medicinals and Botanicals Drug Industry (SIC 2833). According to the 1958 Census of Manufactures, the average production wage rates in 1958 for selected regions

were as follows:

New Jersey - - - - - - - - - - - - $2.64 per hour
New York - - - - - - - - - - - - - $2.58 per hour
U. S. Average - - - - - - - - - - $2.57 per hour
Illinois - - - - - - - - - - - - - $2.45 per hour

There are no published figures for Georgia, but based on similar job requirements, an estimate has been made of $2.00 to $2.13 per hour. In this report $2.13 has been used for calculations.

Because of the above wage differential an Atlanta manufacturer with shipments amounting to $9 million in 1958 could have realized a savings of $156,352 in production labor costs over a similar operation in Illinois. This saving was computed by the following formula:

Value of shipments per production man hour expended -- Illinois

(SIC 2833) = $18.42

Number of production man hours required for $9 million in shipments =

$$\frac{\$9,000,000}{\$18.42} = 488,599 \text{ man hours}$$

Labor savings of the Atlanta plant = 488,599 × ($2.45 - $2.13) = $156,352

A New Jersey producer having the same yearly shipments would save $210,744 in production labor costs, while a New York producer would save $126,800 based on computations by the above formula. However, these cost reductions are based on wage differentials alone and do not include differences in labor productivity between Atlanta and the above locations. They are based on the assumption that the same number of man hours would be required in the North as in the South for the same production. But there are many indications that such is not the case.[1/]

1/ See Charles H. Sewell, A Formula for Labor Productivity in Georgia, July 1961.

A separate calculation[1/] from the 1958 Census of Manufactures based on the relationship of value of shipments in each locality to production wages paid in the same locality indicates the following total production labor savings (other things being equal) of an Atlanta plant over plants in the three states mentioned above:

| | | |
|---|---|---|
| Labor savings of Atlanta plant over Illinois plant | = | $621,000 (51.9%) |
| Labor savings of Atlanta plant over New Jersey plant | = | $513,000 (47.2%) |
| Labor savings of Atlanta plant over New York plant | = | $153,000 (20.7%) |

Thus the combination of lower wage rates and increased productivity would provide a substantial cost advantage to an Atlanta producer.

Water Supply

The Chattahoochee River, which runs through the west section of Atlanta, (Figure 3) is the longest and one of the largest rivers in the state. It empties into the Apalachicola River at the southwest tip of Georgia. The average flow at Atlanta is 1.68 billion gallons per day and steadily increases downstream.[2/] Thus the Chattahoochee should provide more than ample water for an antibiotics plant.

Water Temperature

Since a very large portion of the water used by an antibiotics plant is used for cooling purposes during the production process, the temperature of the water used is of primary importance. Generally, it is desirable to have water not above 60° F. for cooling purposes. Table 2 indicates the average 1961 monthly temperatures of the Chattahoochee River at three separate locations.

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1/ Appendix 2.

2/ The lowest flows on record were 201.8 million gallons in Atlanta (Clayton Sewage Treatment Plant) and 298.7 million gallons at Whitesburg (25 miles southwest of Atlanta).

FIGURE 2
COURSE OF CHATTAHOOCHEE RIVER THROUGH GEORGIA


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Table 2

Average Monthly Temperatures of Chattahoochee River Water, 1961[1/]

| | Buford Dam Area* (30 mi. N.E. of Atlanta) | City of Atlanta Intake Station ** (In N.W. Atlanta) | Whitesburg Area *** (25 mi. S.W. of Atlanta) |
|---|---|---|---|
| January | 49° F. | 45° F. | 46° F. |
| February | 50 | 48 | 50 |
| March | 47 | 53 | 55 |
| April | 48 | 56 | 57 |
| May | 47 | 59 | 66 |
| June | 48 | 64 | 73 |
| July | 49 | 64 | 74 |
| August | 50 | 63 | 75 |
| September | 50 | 64 | 74 |
| October | 50 | 58 | 65 |
| November | 50 | 60 | 56 |
| December | 50 | 50 | 51 |

Source: * U. S. Army Corps of Engineers, Atlanta Office
** City of Atlanta Water Works
*** Georgia Power Company, Plant Yates

It is evident that the temperature of this river water is sufficiently low for cooling purposes without refrigeration during most of the year. The water used during the hotter months would require a minimum of refrigeration before use.

Waste Disposal

The Chattahoochee River, according to a leading authority on water pollution in Georgia, has a relatively low rate of pollution. It is this authority's opinion that the river at a point 10 miles or more southwest of Atlanta's city limits could easily handle the volume of antibiotics waste of most producers. However, since the content and volume of waste varies between individual companies, the need for any filtering ponds and equipment would have to be studied on a company basis. The Chattahoochee would be able

1/ See Figure 2 for location of the three areas.

to handle a large volume of unfiltered waste, however, at a point southwest of Atlanta.

Land Availability

Land is available along the Chattahoochee River in sufficient quantity for antibiotics plants at relatively low cost.

Raw Material

A preliminary check of raw material sources in the Southeast for pencillin manufacture indicates that at least 30 per cent (by weight) of the material required is available in the southern states. At least 53 per cent of the raw materials required for the manufacture of dihydrostreptomycin is available in the same area.

It is indicated that comparable percentages of materials required for the manufacture of other antibiotics are available in the same area.

Transportation of Goods and People

It has been pointed out that Atlanta is an excellent market. This is so not because Atlanta is such a big consumer, but because it is such an excellent distribution point.

Atlanta is the major transportation center of the South. It has the service of 7 railroads, over 75 motor freight carriers, and 6 air freight carriers to deliver products to any point in the United States. The area has a higher volume of freight traffic than any other area in the South.

Liaison with major cities is excellent. Flying time to Chicago is one and a half hours, and non-stop flights are available to most major cities in the U. S. At last count 53 cities could be reached non-stop from Atlanta, and another air line has been added since the count was made.

Research

Since Atlanta is a research and educational center, a manufacturer would be able to obtain either research or research personnel without difficulty

Atlanta's research activities range from food technology to nuclear physics. Business and industry find a wide variety of research facilities and specialists in commercial, institutional, and government laboratories in the Atlanta area.

In addition to the research facilities of private business and industrial firms, nine commercial laboratories in the Atlanta area perform contract research and provide consultation services and testing facilities. These cover such diverse fields as food bacteriology, insecticides, building materials, biophysics, animal nutrition, electronics, electrical engineering, physics, antenna measurement, textile and paper chemicals, and communication systems.

Georgia Tech's Engineering Experiment Station does $4,000,000 worth of research annually, utilizing approximately 350 full time and an equal number of part time research personnel.

Emory University, a private institution of national stature, working closely with the Communicable Disease Center (a division of the United States Public Health Service, headquartered in Atlanta) and with Grady Memorial Hospital, serves as a center of medical research activity.

Oglethorpe University is well known for the cancer research conducted in its laboratories.

In addition to the research capabilities the universities have to offer, they are a continuing source of graduates for industry. Over 3,800 students will receive graduate and undergraduate degrees in 1962 from Atlanta's 19 colleges and universities. Moreover, the Communicable Disease Center trains approximately 6,000 technicians and specialists annually.

## Conclusion

Atlanta is an excellent location for an antibiotics plant because it offers:

1. large quantities of water for cooling and waste disposal,
2. high production per dollar of wages paid,
3. a concentration of research and educational activities,
4. outstanding transportation facilities both for goods and for people, and
5. a large market in the city itself.

There will shortly be a need for industry expansion to supply the growing demand for antibiotics. Atlanta should be a top choice for new plant locations.

# APPENDIX 1

## NATIONAL OUTPUT OF ANTIBIOTICS 1948-1956

| Product | Use | 1948 Pounds | 1949 Pounds | 1950 Pounds | 1951 Pounds | 1952 Pounds | 1953 Pounds | 1954 Pounds | 1955 Pounds | 1956 Pounds |
|---|---|---|---|---|---|---|---|---|---|---|
| Penicillin | M | 155,873 | 247,053 | 402,179 | 599,361 | 638,138 | 726,687 | 906,250 | 643,301 | 886,249 |
| | FS | | | 4,155 | 28,039 | 31,259 | 40,094 | 47,316 | 81,666 | 173,455 |
| Streptomycin | M | 80,737 | 54,312 | 45,657 | 38,686 | 49,665 | 125,135 | 141,244 | 154,415 | 129,774 |
| | FS | | | | | | | | 1,067 | 8,250 |
| | AG | | | | | | | | | 10,975 |
| Dihydrostreptomycin | M | 2,989 | 139,004 | 157,752 | 315,216 | 336,984 | 304,989 | 445,808 | 369,248 | 492,173 |
| Bacitracin | M | 26 | 2,071 | 3,150 | 3,313 | 4,578 | 5,750 | 6,717 | 3,956 | 2,518 |
| | FS | | | | 49,364 | 10,743 | 1,241 | 2,941 | 6,121 | 21,104 |
| Chlortetracycline | M | 661 | 28,517 | 111,242 | 155,563 | 151,967 | 196,955 | 58,592 | 55,556 | 86,504 |
| | FS | | | 31,643 | 93,576 | 160,222 | 281,942 | 284,283 | 281,188 | 465,197 |
| | AG | | | | | | | | | 8,962 |
| Chloramphenicol | M | 46 | 12,608 | 71,570 | 91,771 | 136,676 | 4,892 | 14,151 | 53,365 | 85,408 |
| Tyrothricin | M | | 75 | 55 | 44 | 884 | 159 | | 619 | 1,093 |
| Oxytetracycline | M | | | 36,645 | 56,054 | 123,766 | 147,982 | 186,260 | 152,380 | 145,424 |
| | FS | | | 1,303 | 65,578 | 53,254 | 106,628 | 160,391 | 177,129 | 179,190 |
| Viomycin | M | | | 110 | 123 | 284 | 827 | 2,011 | 2,879 | 3,131 |
| Neomycin & salts | M | | | | 1,495 | 8,161 | 13,102 | 24,747 | 27,721 | 16,896 |
| | FS | | | | | | | | | 29 |
| Polymyxin | M | | | | 1 | 336 | 226 | 407 | 400 | 471 |
| Actidione | M | | | | | 90 | 452 | 952 | 655 | |
| Erythromycin | M | | | | | 2,480 | 39,359 | 64,061 | 53,148 | 70,913 |
| Fumagillin | M | | | | | 355 | 170 | 146 | | |
| Carbomycin | M | | | | | | 2,183 | | 35 | |
| Tetracycline | M | | | | | | 39,753 | 270,235 | 257,065 | 220,074 |
| | FS | | | | | | | | 820 | |
| Nystatin | M | | | | | | | 3,399 | 15,623 | 22,085 |
| Anisomycin | M | | | | | | | | 24 | |
| Cycloserine | M | | | | | | | | 637 | 14,198 |
| Amphomycin | M | | | | | | | | | 73 |
| Novobiocin | M | | | | | | | | | 19,410 |
| Oleandomycin | M | | | | | | | | | 17,815 |
| Candicidin | M | | | | | | | | | 2 |
| Total | M | 240,332 | 483,640 | 828,360 | 1,261,627 | 1,454,364 | 1,608,621 | 2,124,980 | 1,791,027 | 2,214,211 |
| Total | FS | | | 37,101 | 236,557 | 255,478 | 429,905 | 494,931 | 547,991 | 847,225 |
| Total | AG | | | | | | | | | 19,937 |
| GRAND TOTAL | | 240,332 | 483,640 | 865,461 | 1,498,184 | 1,709,842 | 2,038,526 | 2,619,911 | 2,339,018 | 3,081,373 |

Source: Economic Report on Antibiotics Manufacture,
Federal Trade Commission,
U. S. Government Printing Office, June 1958.

M - Medicinal Use
FS - Feed Supplement
AG - Agricultural Use

APPENDIX 2

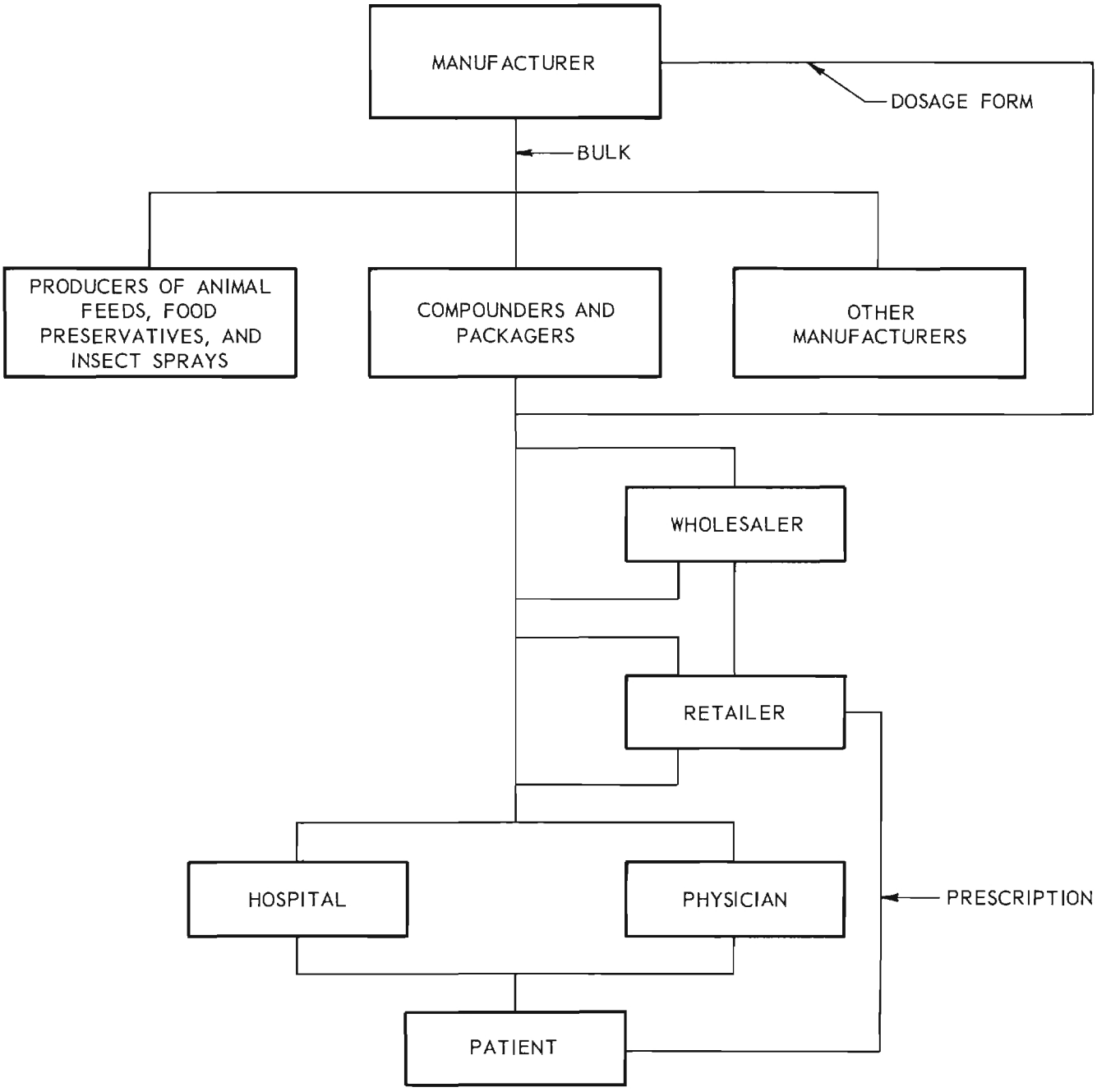
COMPARISON OF LABOR COSTS IN INDUSTRY 2833
FOR $9 MILLION SHIPMENTS IN SELECTED AREAS OF U. S.
(Based on Relationships of Wages Paid in Each Area
to Value of Shipments in the Area in 1958)

Formula: Production wages paid per dollar of shipments (1958)[1/] × $9,000,000 shipments.

| | | Production Wage Cost | − | Atlanta Labor Cost | = | Labor Cost Reduction of Atlanta Plant |
|---|---|---|---|---|---|---|
| Illinois | | | | | | |
| (.133) × ($9,000,000) | = | $1,197,000 | | $576,000 | | $621,000 |
| New Jersey | | | | | | |
| (.121) × ($9,000,000) | = | $1,089,000 | | $576,000 | | $513,000 |
| New York | | | | | | |
| (.081) × ($9,000,000) | = | $729,000 | | $576,000 | | $153,000 |
| South (including Atlanta) | | | | | | |
| (.064) × ($9,000,000) | = | $576,000 | | | | |

1/ This ratio obtained from 1958 Census of Manufactures.

APPENDIX 3
PRINCIPAL ANTIBIOTIC MARKET CHANNELS




SOURCE: *Economic Report on Antibiotics Manufacture*, Federal Trade Commission, U. S. Government Printing Office, June 1958.