AN ANALYSIS OF FACTORS CONTRIBUTING TO COSTS OF HIGHWAY SNOW REMOVAL IN OSWEGO COUNTY, NEW YORK*

By

Robert A. Muller
Dept. of Geography, Syracuse University

In northern New York at relatively low elevations measurable snowfalls can be expected from about November 1 to April 15, a period of five and one half months. The snowfall season is even longer at isolated higher elevations such as on the Tug Hill plateau and in the Adirondack Mountains. At the same time, mean seasonal snowfall ranges from a low of about fifty inches in the Champlain, Mohawk and Hudson valleys to two hundred inches or more on Tug Hill. Snowfall in certain seasons, for example 1946-1947, has reached 350 inches on Tug Hill. The duration of the snow season and the excessive amounts of snowfall in local areas are such that the maintenance of passable roads during the winter season is vital to the proper functioning of the economy and regularly requires a large expenditure of money and effort.

Numerous factors contribute to the costs of highway snow removal. In an analysis of these costs the most obvious are the lengths of roads to be cleared and the varying depths of snowfall. Less obvious are the maintenance of passable roads once they are opened, the types of machinery employed, and the attitudes and objectives of the local highway superintendents. This paper attempts to isolate the more objectively measurable factors, the lengths of road to be cleared and the varying depths of snowfall, and to indicate the others which can only be subjectively considered. On this basis it is then possible to make a preliminary evaluation of the efficiency of snow removal operations in various political units.

The conditions of snow removal in Oswego County, N.Y. are employed as the case study. The county is located at the southeastern end of Lake Ontario and includes a portion of the Tug Hill plateau. For several reasons Oswego County is well-suited for an analysis and evaluation of highway snow removal costs and factors. First, there is an enormous range of mean seasonal snowfall within the county. Figure 1 represents the distribution of mean seasonal snowfall in Oswego County. The figures in Figure 1 are the recorded seasonal snowfalls at cooperative stations; the upper figures are for 1958, the lower for 1957. Figure 1 shows that in the southwestern portion of the county mean seasonal snowfall is about eighty inches, which is representative of much of upstate New York. In the northeastern portion of the county, mean seasonal snowfall ranges to about 200 inches on the western flanks of Tug Hill. This amount is not equalled elsewhere in populated areas of the United States east

*Based on Deep Snow and Its Consequences in Northern New York, by Robert A. Muller, Masters Thesis, Dept. of Geography, Syracuse University, 1959, pp. 64-82.

of the Rocky Mountains. This range of mean seasonal snowfall permits an analysis of costs in towns which normally experience widely different snowfall conditions.

Second, the county has a wide-spread rural farm population, and consequently an extensive road network which must be cleared and maintained during the winter. Finally, the administrative arrangement for snow removal in the county provides reasonably accurate snow removal costs on federal, state, and county highways by towns. For example, the county highway department has a continuing contract with the state for the removal of snow on federal and state highways, and the town highway departments contract with the county for the removal of snow on county roads within each of the respective towns.

The State Department of Public Works has issued maximum machinery and equipment rates on an hourly basis by which the counties may charge the state for highway snow removal. The rates are based on a study by the Department of Public Works of the purchase price, cost of operation, and depreciation of highway department equipment. Similar, but curiously enough, not identical maximum rates have been established to apply to the town departments for clearing county roads.

There are no realistic data available, however, for the costs of snow removal on town and incorporated settlement roads where contracts to other political units for snow removal do not exist. Since snow removal equipment is often multipurpose, that is, the trucks are used for other duties during the summer, published accounts of snow removal costs in town, city, and village budgets usually reflect only the salaries of the operators, and little if any consideration is given to the purchase, maintenance, and depreciation of equipment in these budgetary entries. Consequently, snow removal costs on town roads had to be estimated on the basis of a rate per mile equal to the rate per mile on county roads within each town. For the incorporated settlements estimates by the superintendents of public works were relied upon.

Total snow removal costs within the county for all roads and highways were estimated by a yearly basis for the four years, 1955 through 1958. In Oswego County, where the total population is only about 80,000, the estimated cost on all roads, federal, state, county, town, city, and village, ranged from 590,000 dollars in 1957 when snowfall in the county was only 55 to 80 per cent of average, to about 1,100,000 dollars in 1958, when snowfall was twice the average in the Oswego area, and well above average elsewhere in the county. The 1958 estimated cost in the county, 1,100,000 dollars does not include the considerable aid given to the city of Oswego in the form of snow removal equipment during the record December storm of 1958, when at least 23 plows and their crews were dispatched to Oswego from cities as far as Rochester, 70 miles distant, Syracuse, Auburn, and Watertown.

The following analyses of costs per mile and per "inch-mile", are based on the costs of highway snow removal on county roads by towns and not on

state highways. These costs on county roads by towns provide the most satisfactory data because of the published contract relationships between towns and county for clearing county roads as mentioned earlier.

Any analysis of highway snow removal cost factors must take into consideration the varying road mileages and snowfall within each town. In order to obtain snow removal costs per mile of highway the annual snow removal cost can be divided by the county road mileage in each town. The resultant costs in Oswego County by towns ranged from 36 dollars to 955 dollars per mile during the four year study period in which snowfall ranged from 55 to 200 per cent of the mean.

When the costs per mile are mapped for individual years the patterns are chaotic. For example, in 1958, the pattern of costs per mile in Figure 2 is completely irregular and there is an enormous range of costs from under 300 dollars to over 900 dollars per mile. Towns with high costs are in close juxtaposition with towns with low costs and Figure 2 is of little or no value in the interpretation of snow removal costs. Clearly, snow removal costs per mile are an inadequate measure of snow removal efficiency because of the varying amounts of annual snowfall in each town.

Michigan, another state with similar problems of snow removal, was probably first to attempt the allocation of costs on a basis that provided objective and rather reasonable reimbursements to political units with differing lengths of road and depths of snow. In 1937, Michigan adopted the "inch-mile" formula which provided for a "snow bonus" to counties averaging 60 or more inches of snow each season each year. The United States Weather Bureau prepared a "countour map" of seasonal snowfall each year and provides the state with an overall season snowfall average for each county. This figure is multiplied by the road mileage in each county to provide the inch-mile index. The system of allotments of state funds to the counties has been modified through the years, but the inch-mile formula has remained the same. In 1958 the state of Michigan distributed 500,000 dollars of snow bonus funds to 22 counties, two of which received over 100,000 dollars each.

Using the procedure outlined above, maps of snowfall in Oswego County based on cooperative station records were prepared for each of the four years, and an average snowfall value was assigned to each of the towns for each year. The product of snowfall and county road mileage in each town was divided into the yearly cost, resulting in the cost of highway snow removal per mile per inch of snow. The values of the inch-mile index were mapped by towns on an annual basis.

In Figure 3, which shows the highway snow removal costs per inch-mile in 1958 on county roads, it can be seen that the pattern of costs is much more regular than on the 1958 map of costs per mile, Figure 2, and in addition, that the costs per inch-mile by towns are grouped much more closely about the average for the entire county than the costs per mile. The two middle categor-

ies on both the 1958 cost per mile and cost per inch-mile maps indicate towns with costs close to the respective county-wide averages. In only two towns were the costs of highway snow removal per inch-mile in 1958, Figure 3, considerably above the county-wide average, that is over two standard deviations from the mean, and there were no towns in the four to five dollar per inch-mile category.

In contrast, however, the pattern of costs per inch-mile in Figure 4 for 1957 is considerably less regular. In this year there were three towns considerably above the average for the county, and one town considerably below the average. It has not been possible to detect a valid geographical or distributional basis for this lack of regularity in 1957 as compared with 1958. However, it is now possible to consider other factors which contribute to the lack of complete orderliness in the inch-mile index.

First of all, some disorder may be due to the unrepresentativeness of cooperative climatic stations. It probably is not possible to construct a snowfall map based on cooperative station records which accurately portrays the irregular distribution of snowfall over Oswego County because of the scanty cooperative station network and local relief patterns. This problem is further compounded in Oswego County because of the streaked patterns of snowfall associated with snow squalls off Lake Ontario. The nature of the problem is illustrated by the map in Figure 5 on field measurements of snowfall between December 6 and 11, 1958 in the county. During this six day period between 70 and 75 inches of snow fell in the Oswego and Mexico areas with a belt about 15 miles long and five miles wide receiving at least 60 inches. However, other portions of the county in the extreme north and southwest received less than 18 inches. Similarly, on January 17 and 18, 1959, Bennetts Bridge was buried under 51 inches of snow in less than 24 hours, but snowfall in most of the county was less than ten inches.

A second factor which disturbs the orderliness of the inch-mile index is the subjective determination of further maintenance after the initial clearing of roads. Here it is necessary to consider sanding and salting, the removal of snowbanks along roadsides in order to widen the passable lanes, and the removal of windblown drifts of snow on fair days. Unfortunately, the inch-mile index does not reflect these needed maintenance operations. It might be possible to apply a coefficient of drifting based on the percentage of open land in each town. However, some towns in Oswego County with serious drifting problems do not have unusually high costs per inch-mile. Furthermore, costs per inch-mile may be higher in certain towns less tolerant of small accumulations or where repeated light squalls necessitate continued maintenance.

A third factor of importance is the variable nature of the equipment employed by towns for snow removal tasks. Higher rates per hour are charged for larger and more powerful pieces of equipment. However, a comparison of snow removal equipment in high and low cost towns indicates that only about ten per cent of the cost differences per inch-mile can be accounted for by this factor.

Finally, and probably most significant, are the attitudes and objectives of the town highway superintendents and the "black or red ink" status of the town highway budgets. The allotment of snow removal funds for the town budgets is based on the expectancy of receiving at least normal amounts of funds from the county for clearing the county roads within the towns. If snowfall is much below average, the county funds are not realized by the towns and town funds in the snow removal budgets may not be adequate to meet town highway department payrolls and equipment payments.

During field interviews in early 1959, the remarks of some of the town highway superintendents were collectively about as follows: "Today employees want security with both winter and summer work. Good snow plow operators are hard to come by, and it takes several seasons for experienced operators to become accustomed to local road conditions. If we are to keep the good operators, we must guarantee them a yearly salary. It's not like the good old days when we could pick up a few laborers whenever we needed them. We hope for a good amount of snow each season. In a normal season the county funds will just about meet our payroll over the winter. If there is little snow, we have a budget problem, and besides, there is little else for the men to do."

Although the inch-mile index cannot entirely explain the large range of highway snow removal costs among the towns of Oswego County, the index may, nevertheless, serve as a useful tool for the evaluation of highway snow removal efficiency. If town highway departments operate with the same objective criteria, the inch-mile index can help in the identification of towns with particularly severe snow removal problems. On the other hand the index may help to reveal which superintendents are padding local budgets or performing unnecessary or inefficient snow removal operations.

The latter factor, the attitudes and objectives of the town superintendents, is probably reflected in the cost per inch-mile maps of 1957 and 1958. Snowfall was twice the average in much of the county in 1958; the upper figures on the mean snowfall map, Figure 1, indicate snowfall for 1958 at cooperative stations. For 1958, with the exception of two towns, the inch-mile index pattern on Figure 3 was quite regular. The financial need to perform unnecessary or inefficient snow removal operations was absent for the most part, and indeed, it was impossible to perform the necessary operations at times. In contrast, snowfall in 1957 was only 55 to 80 per cent of the average, the lower amounts in Figure 1, and this is probably the major cause of the lack of orderliness in the inch-mile pattern for 1957 in Figure 4.

In this county, then, where snow removal costs have occasionally approached 1000 dollars per mile, and where rural town roads occasionally serve one dwelling or less per mile, it appears certain that snow removal plays a considerable role in the framework of the town and county economies.

Highway snow removal might be thought of, in a broad sense, as a subsidy from higher to lower political units. State funds are provided to the county for clearing federal and state highways. County funds, in turn, are available to the towns for clearing county roads. Without this subsidy, if it may be called that, rural towns would probably not be able to provide the equipment and services necessary to maintain excellent winter road conditions.

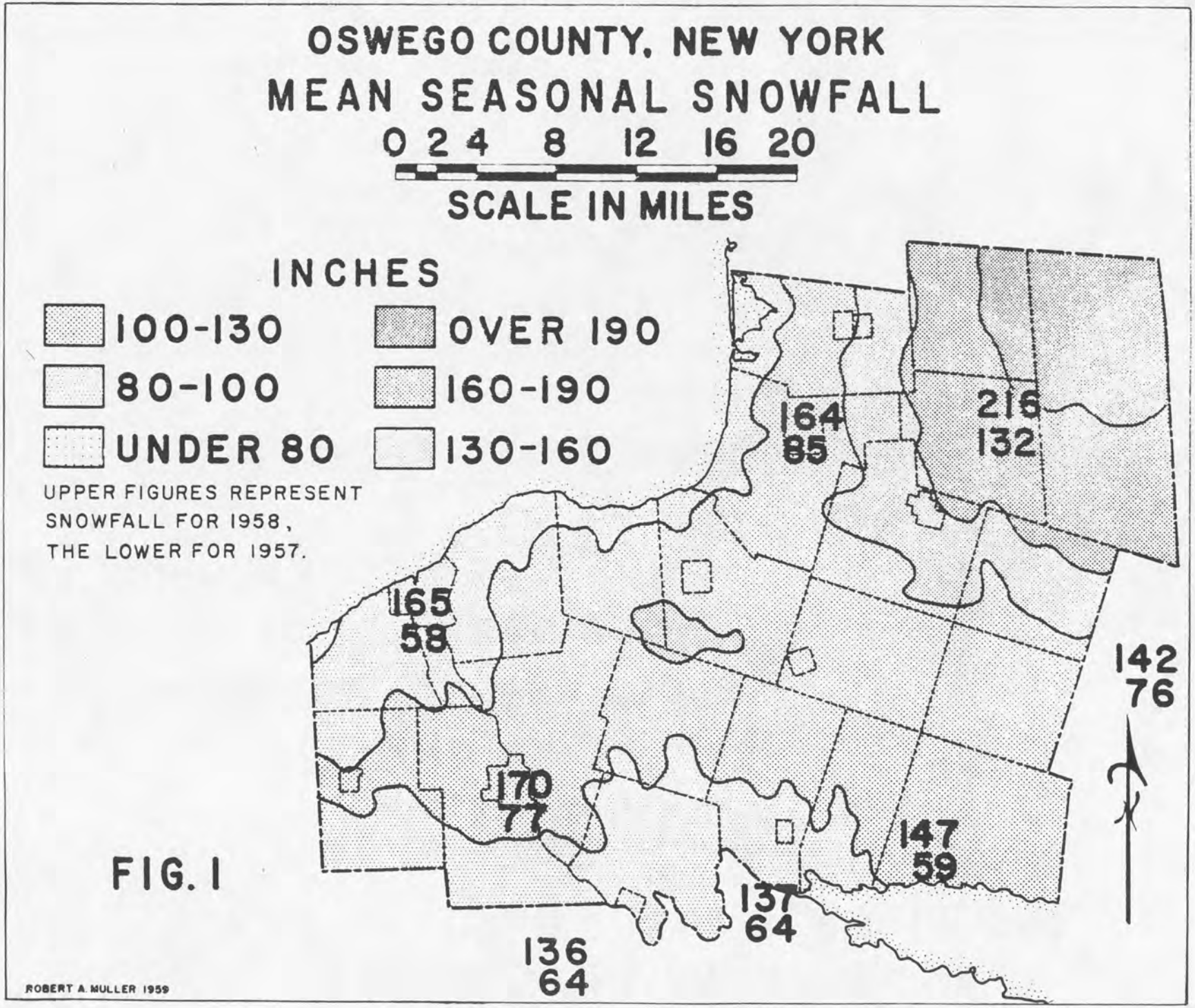
OSWEGO COUNTY, NEW YORK
MEAN SEASONAL SNOWFALL
0 2 4 8 12 16 20
SCALE IN MILES
INCHES
100-130
80-100
UNDER 80
OVER 190
160-190
130-160
UPPER FIGURES REPRESENT SNOWFALL FOR 1958, THE LOWER FOR 1957.
164
85
216
132
165
58
142
76
170
77
147
59
137
64
136
64
ROBERT A. MULLER 1959

FIG. 1

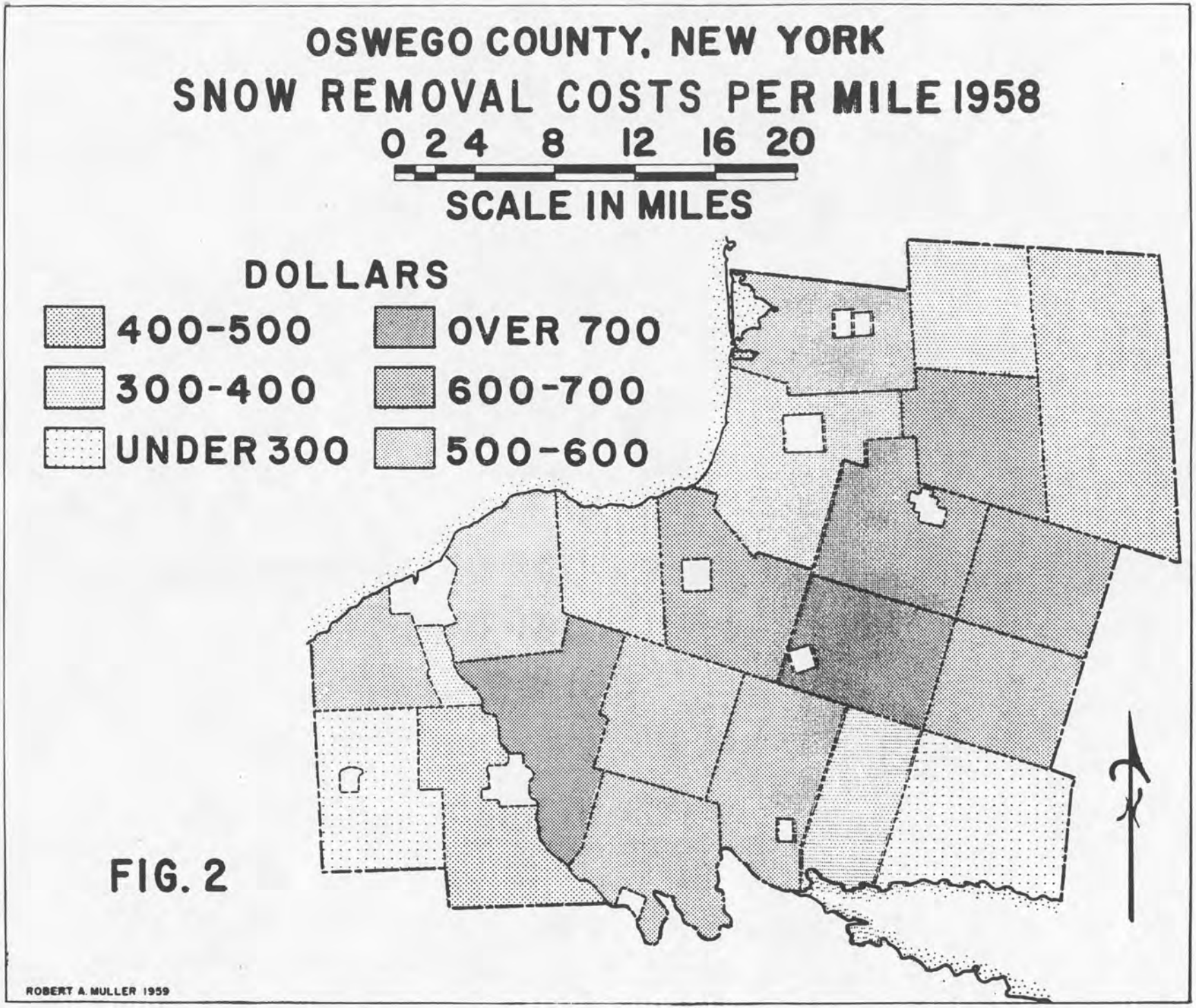
OSWEGO COUNTY, NEW YORK
SNOW REMOVAL COSTS PER MILE 1958
0 2 4 8 12 16 20
SCALE IN MILES
DOLLARS
400-500
300-400
UNDER 300
OVER 700
600-700
500-600
ROBERT A. MULLER 1959

FIG. 2

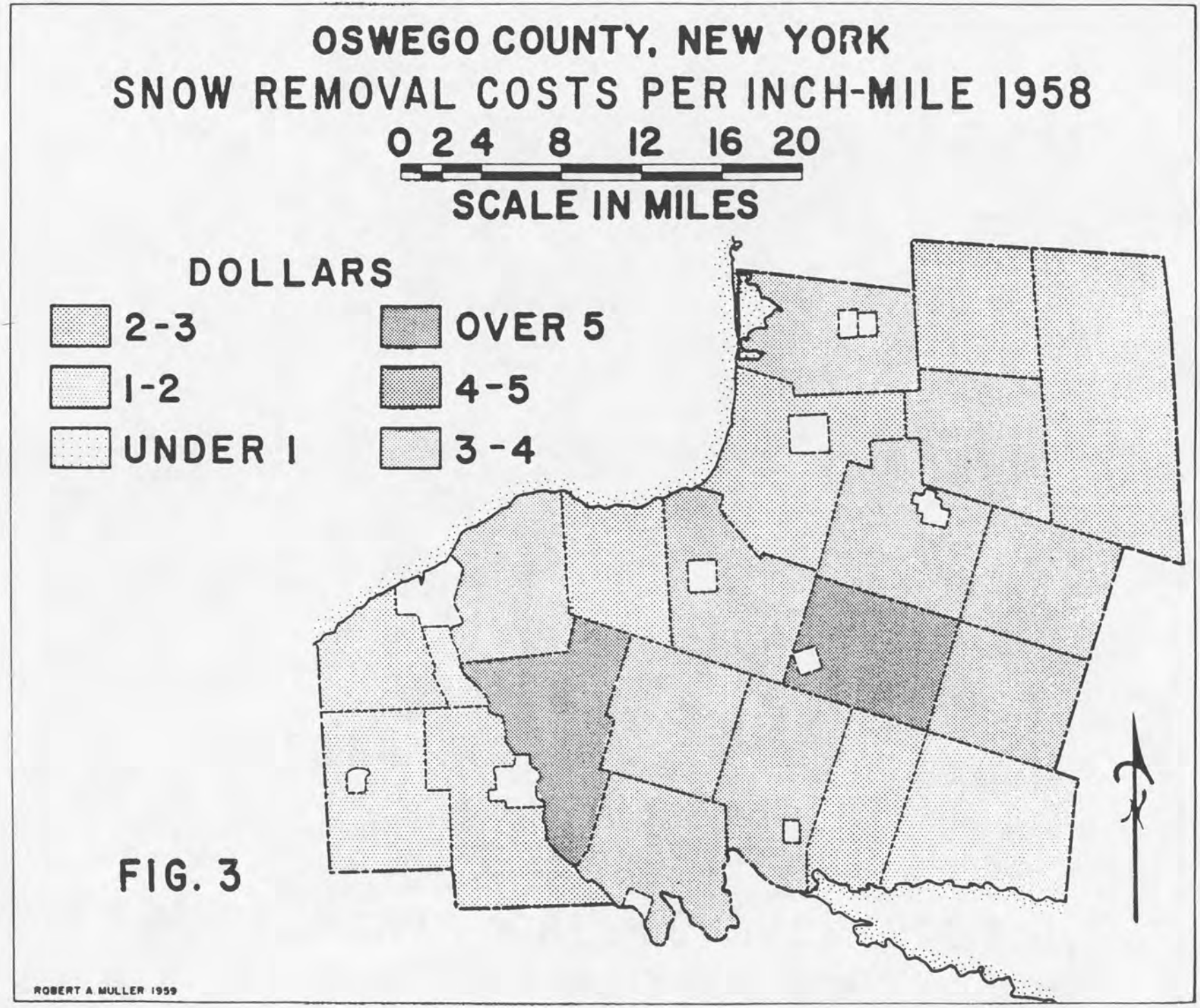
OSWEGO COUNTY, NEW YORK
SNOW REMOVAL COSTS PER INCH-MILE 1958
0 2 4 8 12 16 20
SCALE IN MILES
DOLLARS
2-3
1-2
UNDER 1
OVER 5
4-5
3-4
ROBERT A. MULLER 1959

FIG. 3

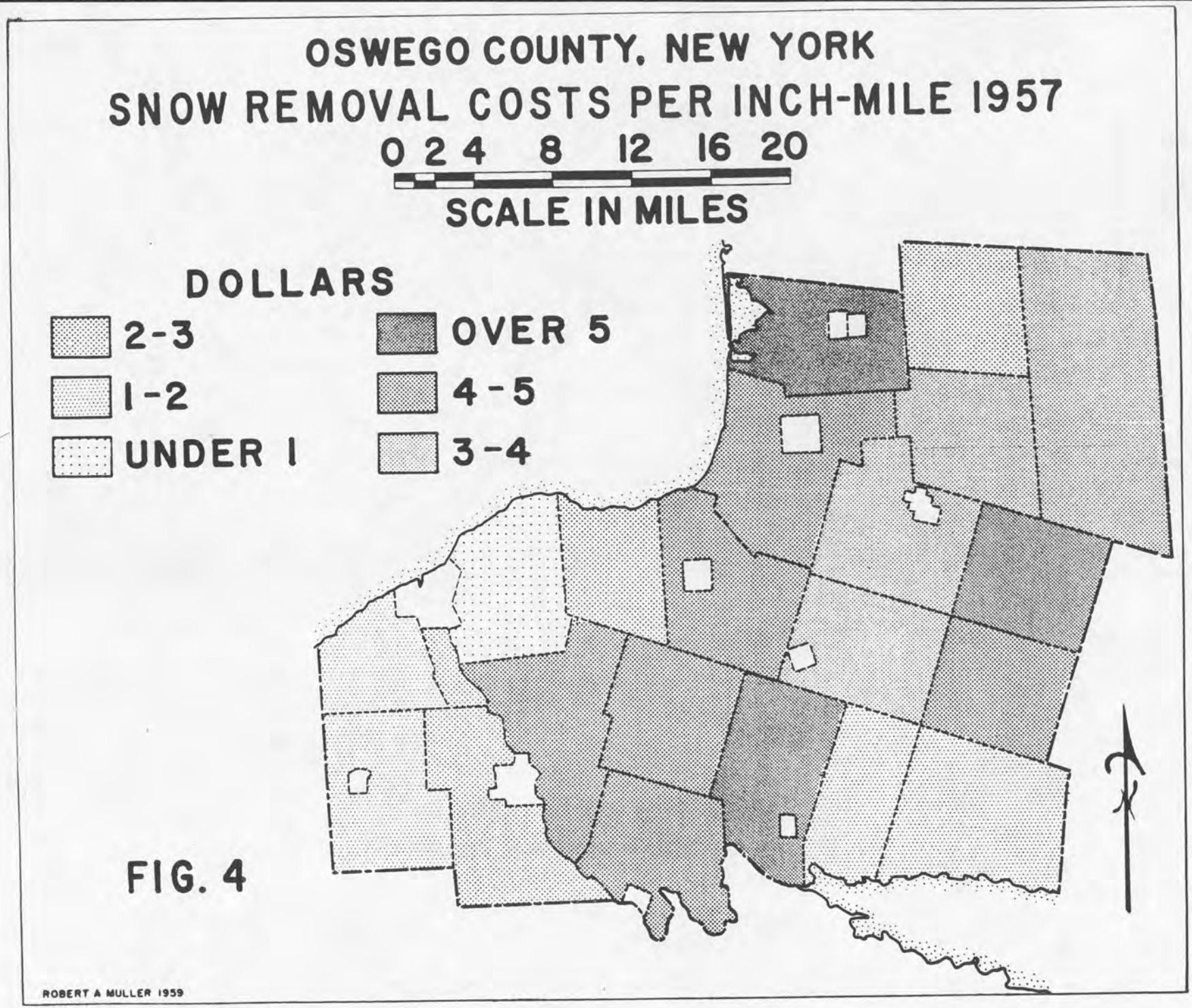
OSWEGO COUNTY, NEW YORK
SNOW REMOVAL COSTS PER INCH-MILE 1957
0 2 4 8 12 16 20
SCALE IN MILES
DOLLARS
2-3
1-2
UNDER 1
OVER 5
4-5
3-4
ROBERT A MULLER 1959

FIG. 4

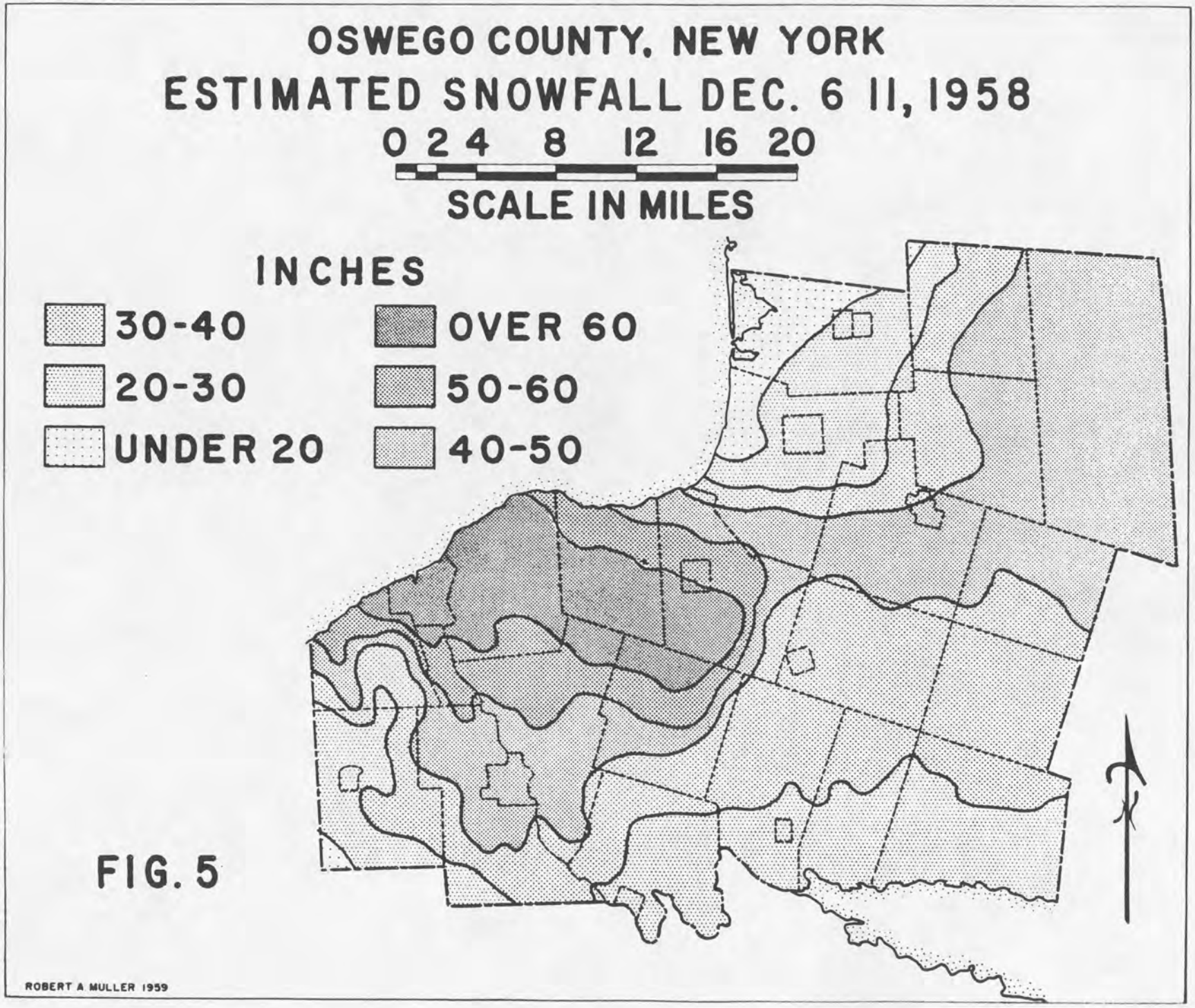
OSWEGO COUNTY, NEW YORK
ESTIMATED SNOWFALL DEC. 6 11, 1958
0 2 4 8 12 16 20
SCALE IN MILES
INCHES
30-40
20-30
UNDER 20
OVER 60
50-60
40-50
ROBERT A MULLER 1959

FIG. 5