FOREST TREE NURSERY ENERGY CONSIDERATIONS

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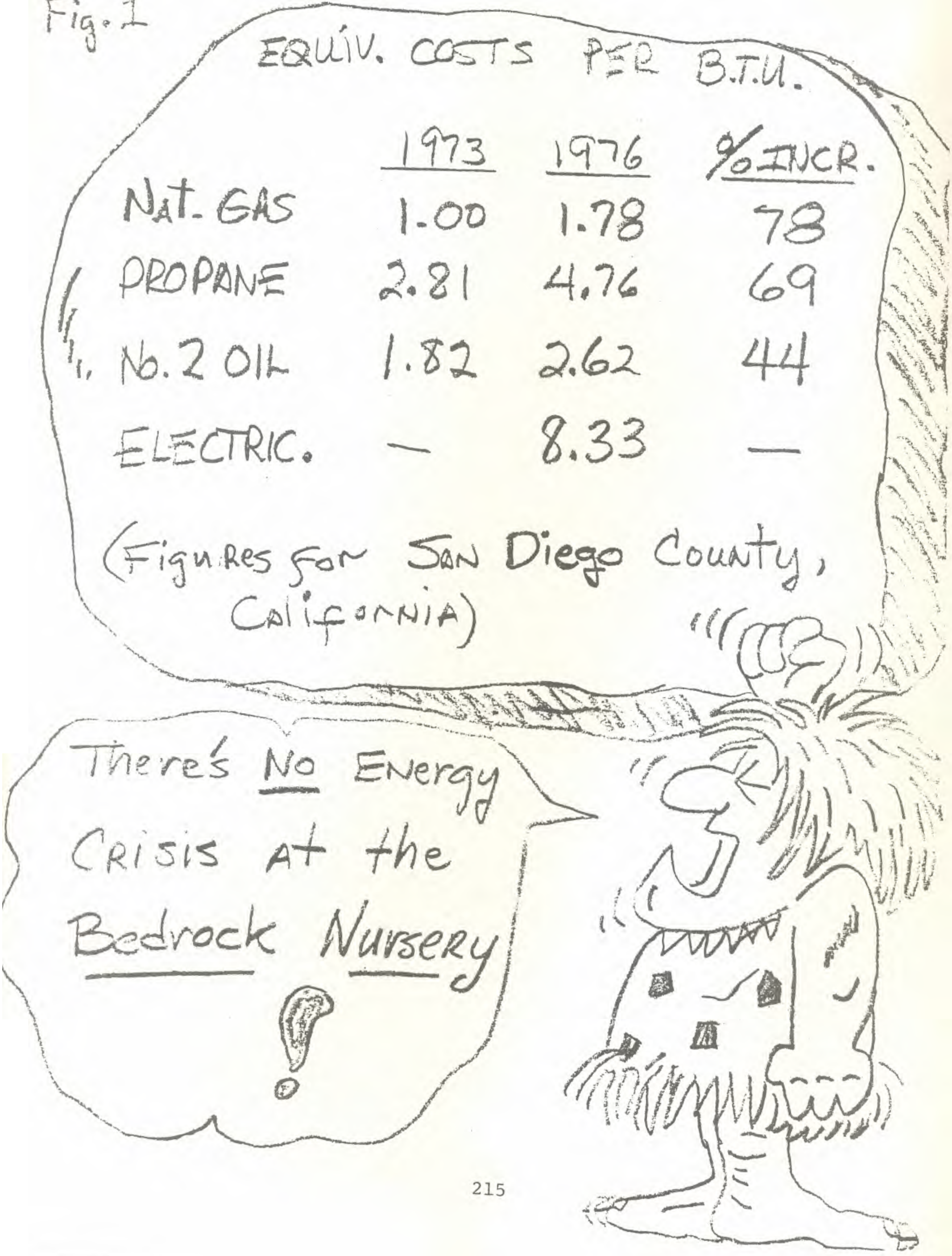
What prompts a discussion of energy at a meeting like this? It is because of the increasing cost and scarcity of energy and how that cost rise and scarcity is affecting our forest tree nursery operations. All forest tree nurseries use electricity for driving irrigation pumps, space heating, lighting, and, perhaps, air conditioning. Likewise all tree nurseries use petroleum products to power wheeled equipment, for space heating, and other applications. Natural gas is often used for space heating, drying cones or heating greenhouses. In early 1973, the United States had the so-called "energy crisis". According to the energy experts, an interim period now exists as far as our oil supply goes. There may even be a global oil surplus in the next 5-10 years. As world demand for oil continues to increase (at a rate in excess of 3% per year), a striking short-fall of global oil supplies is projected to occur in the period 1980-1990. [1] Even though oil is available at present, the price of fuel oil has still increased 100% or more since 1972. Natural gas supplies are becoming critical and in many cases simply no longer available. Cost of greenhouse heating with natural gas in Ohio, where a major segment of the greenhouse industry exists in this country, are now 2 1/2 to 3 times the 1972 price. [2] Many growers in the US using natural gas are under a curtailment and allocation policy which forces them to sometimes supplement their heating needs with other fuels. While electricity is readily available in most areas of the country, its cost is prohibitive for many uses. Figure 1 shows the relative costs of various types of fuels in the San Diego County area of California relating 1973 costs to 1976 costs.' Natural gas in 1973 is indexed as 1. The relation of the other costs are proportional to this index figure. Percentage-wise the price of natural gas has exceeded the cost increases for propane and No. 2 fuel oil. However, both propane and fuel oil started out at a much more expensive level in 1973 and are still much more expensive than the natural gas. Electricity is much more expensive than the three fossil fuels. Figure lA shows a similar situation for the Denver, Colorado, area. [3] The point is that costs are spiralling for the types of energy we use in nurseries. How does this cost escalation and energy acquisition problem relate to nursery operations?

Increased costs of energy for nursery operations can only mean one thing: elevation of the production cost for tree seedlings. Those operations using large amounts of fuel to heat greenhouses and seed extractories will probably be hardest hit. Those units having to only pump water, fuel tractors, and heat some space in offices and work areas will not be impacted

Fig. 1


EQUIV. COSTS PER B.T.U.
1973 1976 % INCR.
NAT. GAS 1.00 1.78 78
PROPANE 2.81 4.76 69
No. 2 OIL 1.82 2.62 44
ELECTRIC. — 8.33 —
(Figures for San Diego County, California)
There's No Energy Crisis at the Bedrock Nursery!

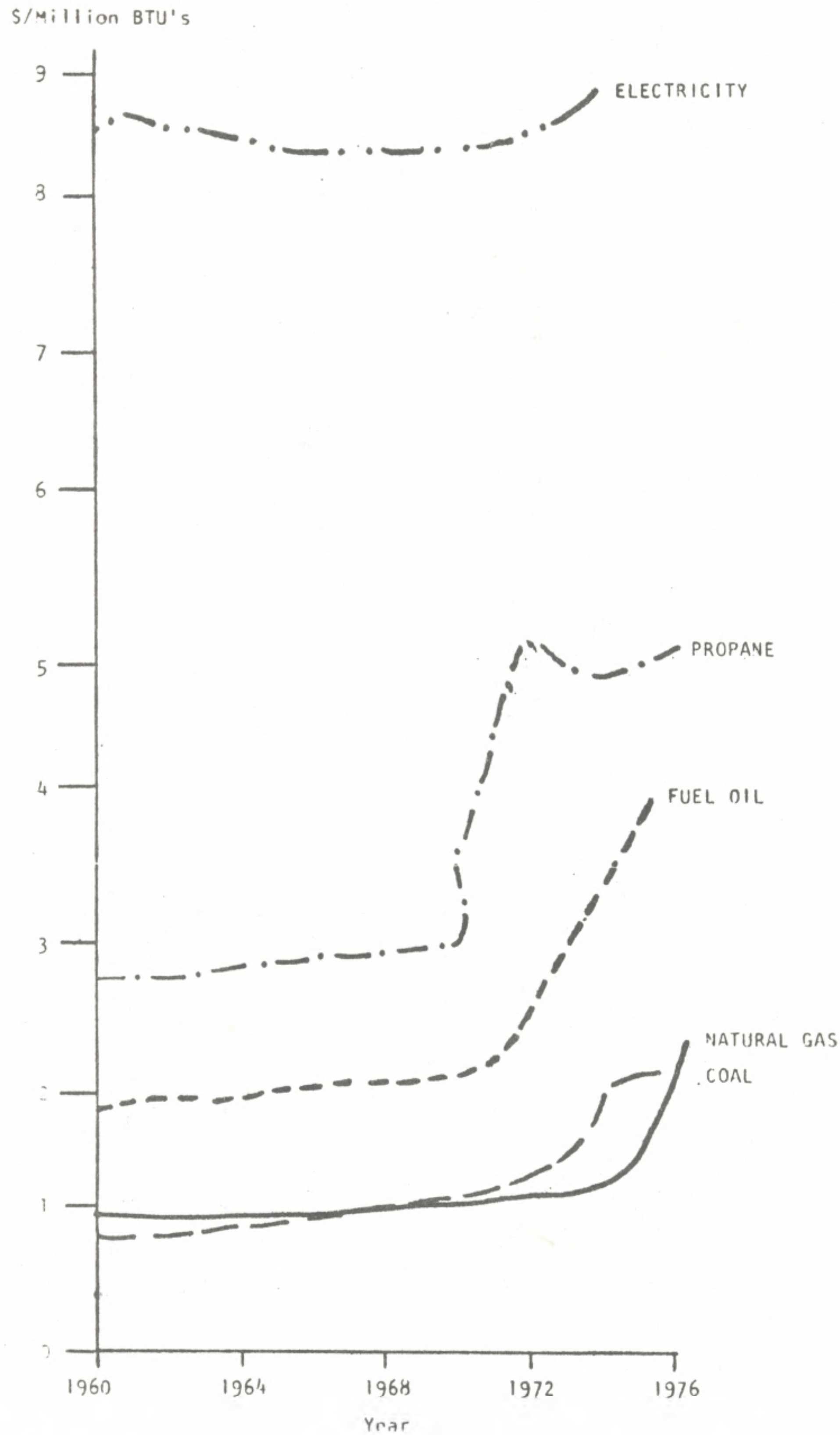


Figure 1a Fuel costs per year in the Denver, Colorado region.

so severely. Nursery operations in mild climates engaged only in bare-root nursery production or semi-controlled-environment containerized tree seedling production will probably not be affected to any degree. On the other hand, those nurseries engaged in a full range of nursery activities, including seed extraction and greenhouse growing of tree seedlings, will probably be affected severely. What can be done to minimize energy impacts on the price of tree seedlings?

There are a number of things we can do as nurserymen, unit managers, and nursery development planners to minimize the impact of the energy crisis on the operations we are responsible for. The first step is to reduce energy use as much as possible. These tactics include conserving heat and electricity through insulation of uninsulated structures, installing storm windows, turning lights out when not needed, reducing office temperatures, and so forth. These recommendations are the same ones the federal government is presently making to the general public as a whole. A number of nurseries have already reduced their containerized seedling tree output from two crops per year (a summer and a winter crop) to one crop a year that is grown during the summer. Another alternative is allowing cones to airdry longer prior to subjecting them to forced drying using heated air. Irrigation of crops at night is often 20-30% more efficient than daytime watering because of reduced evaporation.[4] This can reduce irrigation electrical use. Utilization of diesel-fueled tractors in lieu of gasoline-powered models can result in some savings. Diesel is less expensive than gasoline. Many of our farmers learned some time ago to "gang" a number of cultivation implements, one after the other, to reduce the number of trips the tractor has to make over a field. This gain can range from one to five gallons per acre per year.[5] In many instances forest tree nurserymen can do the same thing, reducing the tractor hours necessary for a given job.

In order to protect our nursery operations from fuel interruptions, there are a couple of other things that we can do. We can install larger fuel storage tanks to tide our operations over supply interruptions that may occur in the next decade. We can convert heating systems for our greenhouses, seed extractories, and work areas from scarce fuels to forms that may be more plentiful, such as coal or wood chips. In some instances, there is the possibility of retrofitting alternative energy hardware to existing structures. This is particularly true of some greenhouses, shops, offices, and seed extractories. Solar energy utilization is often practical in such instances. Even at sites having many cloudy days more solar energy is available than is normally realized. The numerous types of solar collectors available helps make such retrofitting feasible. Increasing national demand for such hardware should make it much more economical to purchase in 4-5 years. At present, lack of mass production of these articles make their unit cost high, but these unit costs should become more reasonable as demand grows. As fossil fuel prices rise, it is logical that nurserymen will have opportunities to retrofit alternative energy application equipment to existing structures. This may occur at the same time the hardware is becoming cheaper. What we need to do is to be aware of this and plan accordingly.

The possibilities of cutting energy use through conservation techniques and retrofitting alternative energy utilization hardware, such as solar collectors, are present at any nursery. On the other hand, many of the opportunities to save energy exist where we currently don't have nurseries. These opportunities can be taken advantage of in two ways: (1) when we are building new nurseries, to include alternative energy planning in site selection and nursery development, and (2) to consider moving high energy using parts of our nursery operations, such as greenhouses and seed extractories, to locations where alternative applications of energy are feasible. Examples of such alternative energy site locations would be places where natural geothermal hot water exists, where there is waste heat from industrial processes (such as electrical power generation and paper pulp mills), locations where large amounts of organic matter in the form of plant or animal residues are available for biogas conversion, locations that have a very high incidence of solar radiation with a few cloudy days, and simply, locations where the climate is very mild and requires little energy input for heating or cooling. Each of these is worth some discussion here.

Natural geothermal hot water occurs in many locations in the west. Electrical power generating companies are looking primarily for natural steam fields and these are relatively rare. However, numerous locations have hot water sufficient to heat seed extractories and greenhouse complexes. Figure 2 shows the known thermal springs that are naturally occurring in the western United States.[6] Of course, there is a much larger resource available that could be developed through drilling. For further general information on this subject, acquire a copy of a report from the U. S. Forest Service Equipment Development Center at Fort Missoula, Missoula, Montana, entitled "Potential for Heating Western Tree Seedling Greenhouses with Geothermal Energy".?

Many opportunities exist to use hot water that is a bi-product of certain industrial processes. These can be manufacturing processes or electrical power generation ones. Currently, there is a greenhouse in operation at Colstrip, Montana, using waste hot water from an electrical generator. There is another in northern Minnesota. The potential for using waste heat from many other industrial processes exists, particularly pulp and paper mill installations.

Another potential source of energy that is significant for forestry and agricultural applications is that of converting organic plant and animal residues into methane gas through biogas converters. Opportunities exist to do this wherever there are large amounts of waste organic matter, such as often exists in the woods, at food processing plants, or livestock feed lots. Larger gas converters are more economically efficient than small ones, and therefore, cooperative efforts may be called for in development of this resource. Biogas has the advantage that it can be generated and then moved to a new location for use, the same as with liquified petroleum gas (LP). Probably, the leading country in the world in utilization of biogas is Australia, where large livestock feed lots in the northwest part of the country provide animal residues that provide most of the fuel for space heating and power generation for several northwestern Australian towns.8

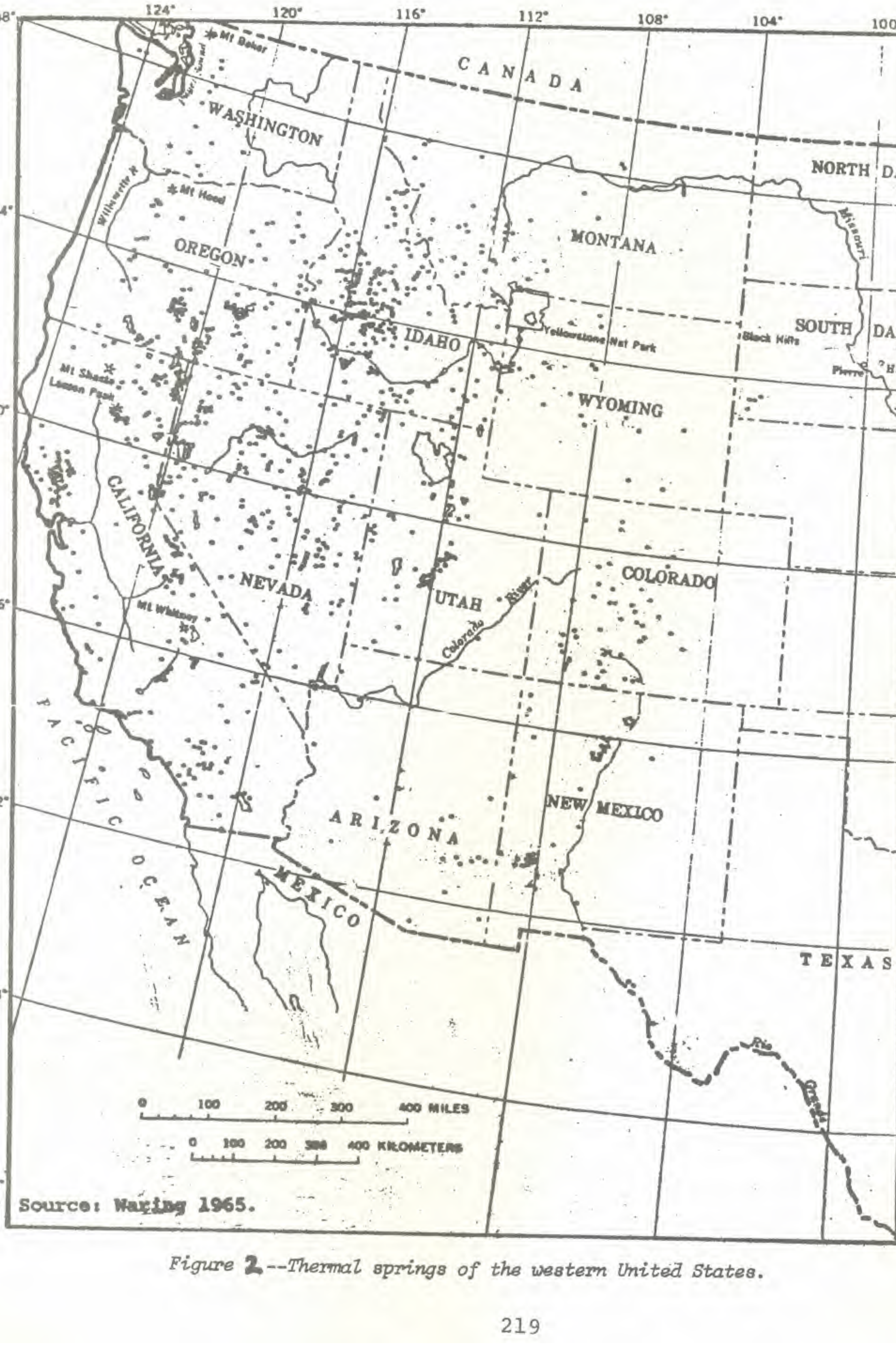


Figure 2--Thermal springs of the western United States.

In the east, considerable work has been done utilizing the ventilation systems of mines to heat greenhouses.[9] The air exhausted from mines has a relatively constant temperature. The degree of this temperature depends on how deep the mine is. The relative humidity of such exhausted air is nearly always 100%. Researchers have found that many plants will grow well in greenhouses heated with such air provided they can tolerate the high humidity conditions." We have opportunities for this sort of thing in the west. Figure 3 shows the number of known abandoned and inactive mines in the US in 1966.[9] Figure 4 is a sketch of an experimental mine-air ventilated greenhouse.[9]

Regarding solar energy utilization, the most solar energy is available where the sun strikes the earth at high intensities and few clouds occur during the year. Data on this can readily be isolated by consulting the Climatic Atlas produced by the Department of Commerce. However, when considering the economics of solar applications, the duration of use in cold winters must be considered. Quite often solar applications in cold areas are surprisingly economical because of this.

And finally, it is well to consider positioning our nurseries and energy demanding operations at locations where the climates are <u>mild.</u> This has inherent cultural advantages as well as energy conservation advantages. Advantages of such site selection will tend to grow as time passes and energy becomes more expensive and scarce.

Evaluation of all these alternatives is particularly important where we are developing a new nursery. Most tree nurseries are planned to have a relatively long life span, and consequently, will be functioning during the crucial period of energy shortage over the next couple of decades. It is important, then, that we locate new nurseries with energy conservation and alternative energy applications in mind, as well as all the traditional site plan factors.

The purpose of this paper has not been to get down to specifics about energy conservation and alternative energy applications at nurseries, but rather to signal the need to consider these things in our everyday work and in planning for the future. It is obvious that energy is going to be increasingly expensive and difficult to get. Therefore, if we can begin to habitually think about how to conserve it and how to apply alternative forms, we will be much better off in the long run.

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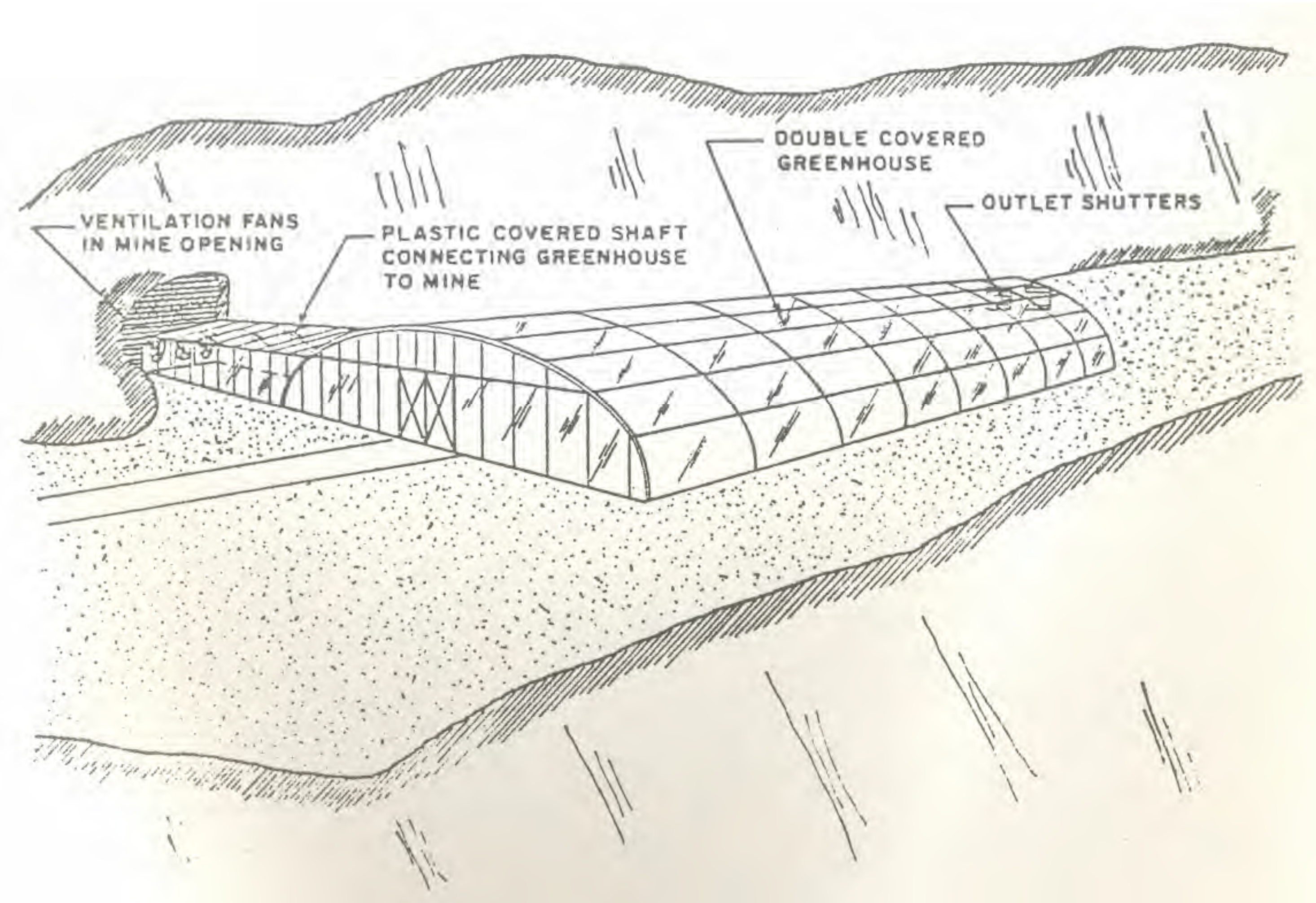

Figure 4 Sketch of the physical arrangement for the experimental mine-air-ventilated greenhouse.

Figure 3. Number of abandoned and inactive mines in the United States in 1966.

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