of protein in these experiments was due to enhanced protein synthesis rather than to cell proliferation, the DNA content of stimulated and unstimulated cultures was compared (Table 2). There was no stimulation of proliferative growth by electrically induced contractions.

The results reported here demonstrate that direct electrical stimulation of contraction of embryonic skeletal muscle cells in vitro enhances the amount of protein produced by myotubes. This increase is greater for the contractile proteins (myosin heavy chain) selectively extracted by pyrophosphate and isolated by SDS-polyacrylamide gel electrophoresis than for total protein within the cell. Furthermore, this increase is not due to enhanced amino acid transport alone, because the specific activity of the proteins is little changed; nor is it due to a selective uptake of leucine per se, because there is a quantitative increase in the protein content of the cells after they have been stimulated. Although electrical stimulation could result in changes in rates of myosin degradation, this alone could not explain the increase in protein content because the increase in the rate of incorporation of radioactive amino acids is comparable to the amount of protein which accumulates.

The role of activity or contraction in the later maturation of muscle fiber is not completely resolved by these or other electrical stimulation experiments in vitro. Cohen and Fischbach (*19*) have demonstrated a decrease in acetylcholine sensitivity and in numbers of receptors in electrically stimulated fibers compared to tetrodotoxin-treated fibers. Shainberg *et al.* (*20*), using the same system, demonstrated that electrically stimulated cultures and unstimulated control cultures (which had spontaneously contracting myotubes) have the same number of acetylcholine receptors, whereas tetrodotoxin increases receptor synthesis. Electrical stimulation is also reported to produce a 30 to 90 percent decrease in the acetylcholinesterase activity of fibers (*21*).

Electrical stimulation that produces an increase in the amount of myosin could lead to the synthesis of the same or different types of myosins within these cells. During work-induced hypertrophy in vivo in the adult, Jablecki and Kaufman (*3*) have shown that the same kind of myosin is synthesized. However, in cross-reinnervated skeletal muscle and in muscle subjected to long-term stimulation through intact innervation in vivo, there can be changes in the physiological and biochemical properties of the muscle cells. For example, during cross-reinnervation both fast and, to a lesser extent, slow muscle acquire the characteristics of the other type with respect to contractile speed (*22*), myosin adenosine triphosphatase activity (*11, 23*), protein subunit pattern (*11–13*), content of metabolic enzymes (*22*), and transport of calcium ions into the sarcoplasmic reticulum (*24*). Moreover, fast muscle electrically stimulated at a rate characteristic of slow muscle acquires contractile speed (*8, 25*), myosin adenosine triphosphatase activity (*8, 10*), and types of myosin light chains characteristic of slow muscle (*8–10*).

The experiments reported here indicate that innervation is not a prerequisite for changing rates of myosin synthesis because the muscle cells we used had never been innervated. They suggest that contraction itself, or electrical stimulation, are sufficient to change the rate of myosin synthesis and accumulation. Although we stimulated these cultures at frequencies consistent with slow muscle (*25*), we do not know the type of light chains synthesized in our stimulated cultures. This system permits modification of the rates of stimulation over a variety of frequencies, so that it should be possible to determine whether or not it is the rate of contraction which results in differential gene activation and the consequent production of different myosin light chains.

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Need for a Better Solar Radiation Data Base

In 1965 Bennett (*1*) completed his analysis of the available solar radiation data in the United States and warned about the problems in using these data. And in August 1972 the National Weather Service ceased publishing solar radiation records because of the poor quality of the data (*2*). Despite these warnings, highly questionable data have been used in studies involving the location and design of solar electrical power plants.

On the basis of the data available in 1962, the National Oceanic and Atmospheric Administration (NOAA) prepared insolation tables and maps that appeared in the *Climatic Atlas of the United States* (*3*). The station at China Lake–Inyokern, California, stood out in this publication as receiving far more solar radiation than any other location in the United States. This was duly noted and accepted by most climatologists. In 1965 Sellers (*4*) said, "Inyokern, California, at an elevation of 744 m in the arid rain shadow on the east side of the southern Sierra Nevada Mountains receives more solar radiation during the year than any other point in the United States for which data are available."

However, in 1966 the National Weath-

Table 1. Apparent changes in Eppley pyranometer calibrations. Data are from (5).

Station	Serial number of sensor	In use since	Date of field comparison	Apparent correction (%)	
				Total	Mean annual
Inyokern, Calif.	1620	1 November 1950	23 September 1966	−16.7	−1.0
	2010	New		+3.8	
Bismarck, N.D.	593	13 August 1959	5 October 1966	+9.4	+1.3
Great Falls, Mont.	1761	15 March 1960	3 October 1966	+15.0	+2.3
Sterling, Va.	1809	26 October 1960	12 October 1966	−3.7	−0.61
Columbia, Mo.	1779	9 October 1961	14 September 1966	+7.0	+1.6
	2060	New		−2.5	
Phoenix, Ariz.	1572	8 June 1962	20 September 1966	+12.2	+2.9
Fresno, Calif.	3046	4 February 1963	27 September 1966	+4.4	+1.3
Ely, Nev.	1975	15 March 1963	30 September 1966	+6.9	+2.0
Madison, Wis.	2955	25 May 1965	7 October 1966	+1.8	+1.4
Davis, Calif.	659	14 July 1965	28 September 1966	+1.7	
Dodge City, Kan.	2064	12 November 1965	16 September 1966	+7.8	
Las Vegas, Nev.	1712	24 November 1965	22 September 1966	+0.8	
Twin Falls, Idaho	386		1 October 1966	+2.5	
Albuquerque, N.M.	1811		18 September 1966	+2.8	

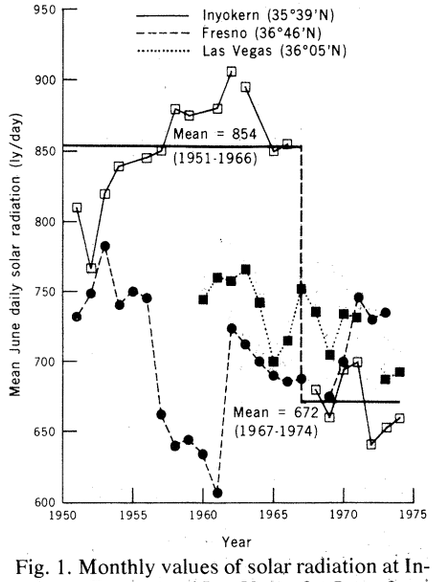

Fig. 1. Monthly values of solar radiation at Inyokern, Fresno, and Las Vegas for June, from 1951 to 1974. Breaks in the lines indicate missing data. June was chosen as the best month to portray readings because of the lack of clouds at that time of the year. Data are from NOAA's National Climatic Center, Asheville, North Carolina.

Table 2. Mean daily solar radiation (MDSR) in langleys (ly) at Inyokern (35°39′N), Fresno (36°46′N), and Las Vegas (36°05′N). Data are from NOAA's National Climatic Center, Asheville, North Carolina.

Month	Inyokern			Fresno			Las Vegas		
	MDSR (ly)		Difference (%)	MDSR (ly)		Difference (%)	MDSR (ly)		Difference (%)
	1951–1966	1967–1974		1951–1966	1967–1973		1960–1966	1967–1972	
January	325	261	−19	186	170	−8	296	273	−7
February	432	334	−22	293	267	−8	384	360	−6
March	587	470	−19	438	420	−4	515	495	−4
April	720	595	−17	549	555	1	630	630	0
May	810	652	−19	639	648	1	710	691	−3
June	854	672	−21	701	687	−1	740	725	−2
July	808	632	−21	683	679	1	696	631	−9
August	747	574	−23	612	611	1	637	595	−7
September	655	523	−20	507	504	1	556	533	−4
October	489	380	−22	378	369	−2	422	415	−2
November	362	276	−23	239	217	−9	302	295	−2
December	295	242	−17	161	156	−3	262	239	−9
Annual	590	468	−20	449	440	−2	513	490	−5

er Service made calibration checks on a number of instruments at various locations in the United States (5). Data from this report appear in Table 1. The China Lake–Inyokern record was 16.7 percent too high. The errors in the record resulted from a whole series of instrumental problems that began shortly after the first sensor was installed in late 1948. In 1951 it was pointed out that the data were averaging about 10 percent above normal (6). In 1957 the observers reported that they felt that the equipment was out of calibration (7). Between then and 1966 other instrumental difficulties were reported (8). In Table 2 the Inyokern record is compared with records for Fresno and Las Vegas—stations that should record comparable values (also see Fig. 1).

In spite of the fact that these problems with solar radiation data and with the Inyokern record were well known to meteorologists generally, engineers associated with the energy program have continued to use them. One study concluded that Inyokern South was the best site for the location of a major thermal electric generating plant to be funded by the federal government (9). And in a recent article the China Lake–Inyokern data were again cited in an analysis of the efficiency of solar collectors (10). In both of these reports the China Lake–Inyokern data that appear in NOAA's *Climatic Atlas* appear to have been used.

The example cited here is only one of a number of cases where individuals and agencies have accepted and used solar radiation data without questioning the quality of the data. But the problem is not so much in the misuse of the data as it is in the quality of the data that are available. It points up the need for a vastly expanded federal program to rehabilitate the old data and to develop reliable solar sensors that will provide accurate measurements of solar radiation in all parts of the United States. To continue to proceed in the future as we have in the past will cost the taxpayers of this nation millions of dollars for solar equipment that is improperly sized because of the lack of an adequate data base.

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