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NORTH AMERICA



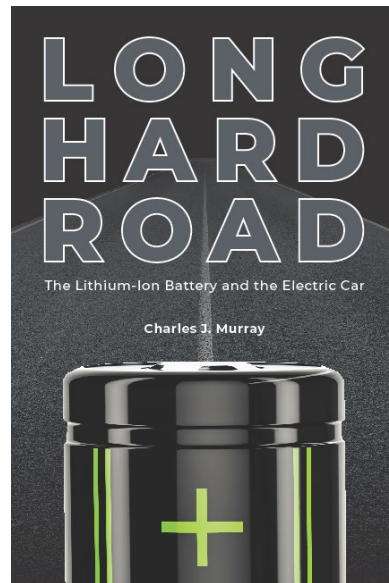
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Ten Things You Didn't Know About the Lithium-Ion Battery and the Electric Car

Charles J. Murray

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- Based on “Long Hard Road: The Lithium-Ion Battery and the Electric Car”



#TBS22 #EVT22

Question 1

- In what year was the first manufacturable electric vehicle developed?

Answer: Thomas Parker developed the first manufacturable EV in the UK in 1884. (Photo: Wikipedia)



By 1900, 38% of the vehicles on American roads were electric. (Photo: Wikipedia)



Question 2

- In 1913, two American icons teamed up to build a better electric car. Who were they?

Answer: Thomas Edison and Henry Ford (Photo courtesy of the collections of The Henry Ford)



Edison-Ford Electric Car in The New York Times, January 11, 1914.

EDISON BATTERIES FOR NEW FORD CARS

Automobile Man Discusses Possibilities of New Storage System with Its Inventor.

LAUGHS AT WALL ST. ATTACK

Impossible to Corner Motor Industry, He Says—Rumors as to His Investments Amuse Him.

Henry Ford, the automobile manufacturer, whose plan to share \$10,000,000 of the profits from his plants with the employes has caused so much comment, not only in the automobile industry but in the business world in general, will return to Detroit this afternoon at 5 o'clock. Mr. Ford has been stopping at the Belmont Hotel and has enjoyed his visit immensely, despite the hundreds of visitors who have kept watch on his movements in the hope of interesting him in some of their ideas. "I am going back to-morrow," he told the reporters, "simply because I want to be at the helm when my plan goes into operation. I'm not seeking notoriety; I'm just doing what I think is right. My visit has been a profitable one, too. You probably want to ask me something about my talk with Thomas A. Edison at West Orange, yesterday. Well, I think Mr. Edison is the greatest man in the world and guess everyone does. Within a year, I hope, we shall begin the manufacture of an electric automobile. I don't like to talk about things which are a year ahead, but I am willing to tell you something of my plans.

The fact is that Mr. Edison and I have been working for some years on an electric automobile which would be cheap and practicable. Cars have been built for experimental purposes, and we are satisfied now that the way is clear to success. The problem so far has been to build a storage battery of light weight which would operate for long distances without recharging. Mr. Edison has been experimenting with such a battery for some time.

The car we propose to build will contain a battery equipment weighing 40 pounds and the entire car will weigh but 1,100 pounds. It will run for 100 miles. The cost will be about \$800 to the public. How does that compare with the great heavy and expensive electric cars?

The next problem, Mr. Ford explained, was the planning of machinery of the proper weight, strength and

design to operate such a car. When regulations are completed and the battery and machinery are ready to place upon the market, it is Mr. Ford's intention to have the cars manufactured at a new plant, which will be in charge of his son, Edsall Ford. The batteries will be manufactured by Mr. Edison.

"Will you introduce the profit sharing plan in the new factory for electric cars?" Mr. Ford was asked.

"Well, there may not be any profits at first and that might make some difference for a time," he said. "As for the adoption of the 50 minimum wage in the new factories, one thing is certain, all the Ford shops will pay good wages. Now I've told you all that, so please don't ask me what is going to happen a year from now."

Mr. Ford said that he had also talked over with Mr. Edison the question of using moving pictures for the instruction of men in his shops.

"We took half a dozen films at the Edison works yesterday which will be shown to my men in Detroit," he said. "I believe that it is one of the best ways to instruct the men. It isn't even necessary that a man should be a skilled mechanic. Often we can make the workmen out of the men who know nothing about the business when they start with us."

Judge Ben Lindsey yesterday talked over with Mr. Ford his moving-picture idea, and his general welfare proposition.

The Judge is greatly interested in all these matters. "Mr. Ford," he said, "we had a most profitable and enjoyable talk. He wanted to know about the co-operative plan and the minimum wage."

One of the reporters showed Mr. Ford an attack upon him published by a Wall Street stockholder.

"I want to hear that read it out loud," he said.

The statement was to the effect that the manufacturer was putting through his plan in order to reduce the profits, which would otherwise go to a firm which held 15 per cent. of the Ford stock, and also that Mr. Ford hoped to corner the supply of skilled labor at a prohibitive price, and thereby stifle the competition of the same firm, which it was said had intended to start the manufacture of a cheap automobile.

"Now I'll tell you first that Wall Street can't control the automobile industry," said Mr. Ford with a smile.

The firm mentioned owned but 10 per cent. of the stock, and this is the first I had heard that it intended to manufacture automobiles. The firm does but little work for us and as far as I know there hasn't been the slightest division of opinion over the plan of profit-sharing.

A statement in an evening paper to the effect that Mr. Ford had some \$10,000,000 deposited in Detroit banks, and that he never made any investments gave the manufacturer some amusement.

"It is true that I don't make many investments, although I have \$2,000,000 invested," he said. "It is a case of no gold mine for me. I'm not taking any risk, anyway. I've got enough money, so why discuss it? Detroit banks, and the bankers there have none of any of them for a million at a time. I have deposited my money in banks in various sections of the world."

During the interview, which took place in the Belmont lobby, a dozen men who had been waiting about most of the

afternoon to see the inventor, kept on the outside ready to grab him when the reporter left. Mr. Ford ordered them by ducking into the change room. A photographer asked him if he could induce Mr. Ford to pose for a picture.

"No, Mr. Ford wanted to keep out of this," he said with a smile. "The hug enough on her hands taking care of us. Mr. and Mrs. Ford and their son, Edsall, went to the theatre last night to see Harry Lauder, the Scotch comedian."

EDISON PRAISES MACHINES.

They Aid the Working Man and Shorten Hours, He Says.

Thomas A. Edison expressed the opinion at West Orange yesterday that the Ford profit-sharing plan was the beginning of a new period in industrialism and was due to high efficiency with machinery. If generally adopted, he said, it would do away with labor unions.

"This great scheme of Mr. Ford's will do a world of good," he said. "When we use machines instead of humans and have a single apparatus to do the work of 200 men, then employes will enjoy real benefits. This is already true in the Ford factory in Detroit. It is a case where scientific management has rolled up enormous profits, because an article can be very cheaply manufactured."

"Mr. Ford struck the right note when he found he could sell his car for 50 cents cheaper some time ago. Then when efficiency in manufacture made it possible to make a car for 100 cents, he decided that his employes should have the benefit. It is a good scheme, while the Ford people are prosperous, and it is only natural that the wages of the workers should decrease."

"The time is passing when human labor alone can do the work of the world. To-day putting brains into machinery, the energies of thousands of humans with their hands, are doing the work of one apparatus keeps working. If other countries were to follow the Ford plan, the question of efficiency and reduce operation cost, then employes would be well off."

"The Ford machinery, went on Mr. Edison, would necessitate men working less hours and at the same time would enable them to accomplish much more, thereby making it possible to have machinery, used in the manufacture of his cars, which could be operated by a girl and which did the work of a man."

Continuing, Mr. Edison said that in a dozen years, with such machinery, American manufacturers would be able to compete with the Germans and other manufacturers.

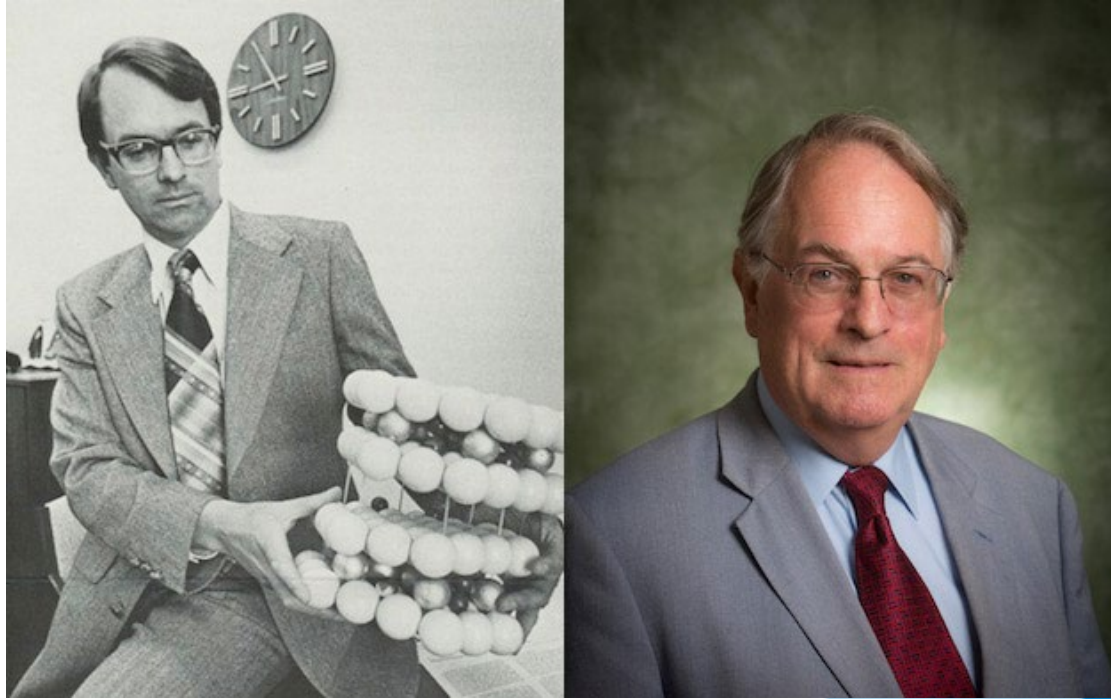
"Machinery is the salvation of the American manufacturer," he said, "and will result in the United States leading the world commercially in a few years." He said that he had been asked to make about the present system of education, saying that it was a remnant of the old Latin institutions and was too

"What we should have," he said, "is education in the sciences. Mr. Edison is planning to go to Florida next month to work in his laboratories there."

Question 3

- In what year was the first rechargeable lithium battery developed?

Answer: 1972 by Stanley Whittingham at Exxon Corp. (Photo courtesy of Exxon Corp.)



Question 4

- In 1979, a company outside the auto industry offered to teach automakers how to build hybrid cars. What was the name of that company?

Answer: Exxon Corp.



Exxon brochure

- “Detroit, your future can be both as big and as small as America wants it.”

Question 5

- Who invented the lithium cobalt oxide cathode in 1980, and where was it invented?

Answer: John Goodenough at Oxford University (Photo: Nobel Media/A. Mahmoud)



Question 6

- During the 1980s, which companies built the first lithium-ion batteries in a lab?

Answer: Asahi Chemical and Sony Corp.

(Photo: Nobel Media/A. Mahmoud)



Question 7

- In what city was the first lithium-ion production battery built?

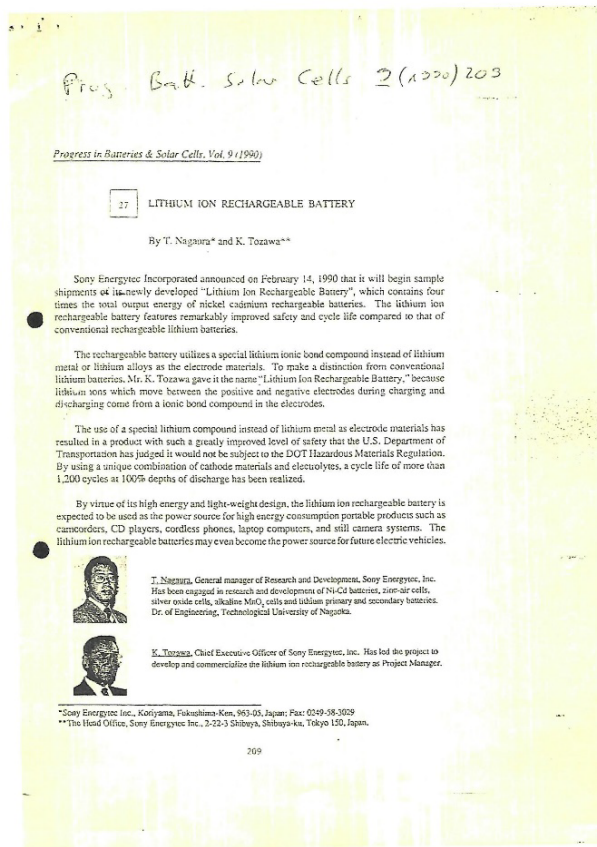
Answer: Boston, Massachusetts, by Nikola Marincic (Photo courtesy of Lidija Ortloff)



Question 8

- What company introduced the first commercial lithium-ion battery to reach high-volume production?

Answer: Sony Corp. in 1991



Question 9

- Which company introduced the first lithium-ion-based electric car?

Answer: Nissan Motor Corp. in 1998



Question 10

- In 2003, which was the first company to develop a lithium-ion-based car using 18650-type batteries?

Answer: AC Propulsion (Photo: Tom Gage)



AC Propulsion Tzero (Photo: Tom Gage)



AC Propulsion Tzero

- Battery pack: 6,800 cells
- 68 cells per module
- 100 modules
- Designed its own motor and inverter

Tesla Motors Roadster (Photo: Wikimedia)



Tesla Roadster

- Battery pack: 6,831 cells
- 69 cells per module
- 99 modules
- Licensed motor and inverter from AC Propulsion

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Thank you!

Questions?