

PHYSICS—INVENTION

# Invention Makes Electricity Directly From Sunlight

## Discovery of German Scientist Increases Current Output From Light-Sensitive Cells More Than Fifty Times

**T**HE PROBLEM of using the vast energy of the sun for human purposes is nearing a solution. Dr. Bruno Lange of the Kaiser Wilhelm Institut, Berlin, has recently perfected a device which converts sunlight into electric current more completely than ever before, at a price that may compete with present hydroelectric installations.

The exhaustion of our coal supply in a few hundred years is no longer to be feared if Dr. Lange's claims are justified. On the contrary we shall now have access to enormously more power than ever before. An expansion of human engineering activities to a new scale, similar to what happened after the invention of the steam engine, is foreshadowed by this latest development in photoelectricity.

Talking pictures, television and automatic control devices in every branch of technology will be the first to benefit by the new light-sensitive cell. Light-sensitive vacuum tubes containing potassium or caesium, which have played a fundamental part in recent engineering developments, will probably be replaced in most of their uses by the cheaper and simpler Lange device.

Silver selenide is the substance that best does the trick of converting light to electricity at present. A sheet of metal is covered with a thin layer of silver selenide which in turn is coated with a transparent layer of a second metal only a few molecules thick. Light passing through the transparent film sets up a current between the two layers of the metallic sandwich.

Fifty to a hundred and fifty times more current is obtained from this than from a similar sandwich of copper oxide between two layers of copper, which was the immediate forerunner of the silver selenide cell. The superiority of the copper oxide sandwich over all other converters then known was discovered three years ago. Experiment has verified the conjectures about the possible applications of such cells. A copper oxide cell three inches square

has driven an electric motor by dull sunlight for some months now in the Siemens Laboratory in Berlin.

Rival patents have been taken out in the British patent office on the copper oxide invention both from America and from Germany. Dr. L. O. Grondahl and Dr. Paul H. Geiger of Pittsburgh are the American inventors. Dr. Lange invented the German form of the cell. The terms of his patent are sufficiently general to cover the use of silver selenide and other substances as well as copper oxide.

The Westinghouse Company are the owners of the American patent, while the German invention belongs to Siemens and Halske, another large electrical concern.

### Use of Silver Selenide

Silver selenide is a very late arrival on the field. The discovery of the principle on which the invention depends was made with the copper oxide sandwich about which, therefore, much more is known.

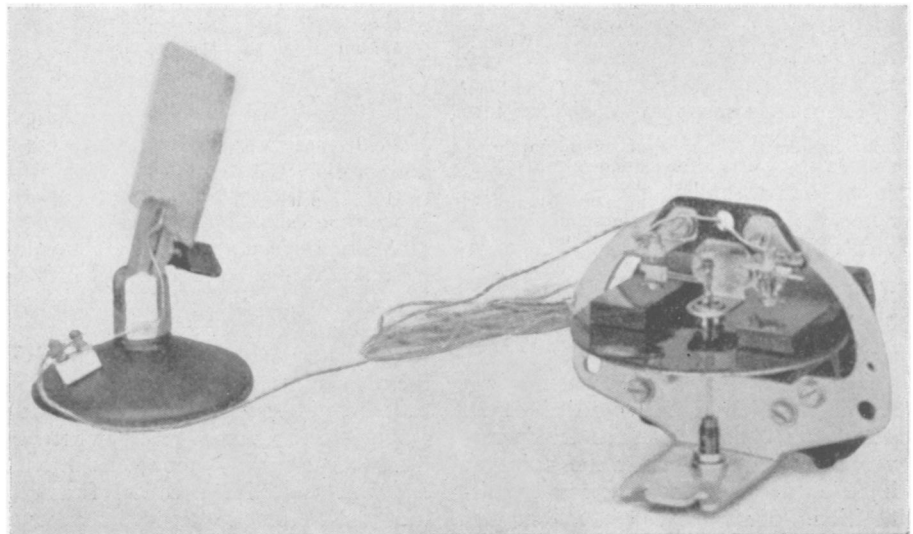
The Grondahl-Geiger invention has

thus a longer history than Dr. Lange's. Dr. Grondahl had previously devised a cell almost identical with the photocell sandwich for use as a rectifier, that is, to convert alternating current into direct current. The rectifier has already been completely successful commercially.

A coil of copper wire pressed on top of the oxide by a plate of glass forms the upper electrode of the Grondahl photocell. Dr. Lange, however, deposits a thin layer of copper or other metal by cathodic sputtering on the cuprous or other sensitive substance. A wide mesh grid of metal is fixed to this. By this means Dr. Lange is able to obtain larger currents from the copper oxide sandwich using a given strength of light. The selenium compound, whose use has just been announced, still further increases the efficiency of the cell.

Dr. Lange's first contribution consisted in giving the cuprous oxide cell a more favorable, more applicable form than ever before, though a number of other investigators deserve credit for the scientific groundwork on which his advance is based.

The very first light-sensitive cell was of selenium made in 1885 by Warner Siemens, gifted co-founder of the company which is now developing Dr. Lange's invention. Sulphides of silver, lead and molybdenum have also been used for some time with very small efficiency. Dr. A. H. Pfund of the Johns Hopkins University, and Dr. W. W. Coblentz of the (Turn to page 235)



**COPPER OXIDE LIGHT-SENSITIVE CELL AND MOTOR**

*This cell, left, has been running the small electric motor, right, in a laboratory in Berlin for some months. The new development uses silver selenide to greatly increase its efficiency and brings the commercial production of electrical power from sunlight within the realm of possibility.*

PHYSICS—INVENTION

# New Photoelectric Sunmotor Discussed By Its Inventor

By Dr. Bruno Lange

Kaiser Wilhelm Institut, Berlin

(In an interview with a Science Service correspondent)

**P**ATENTS on the newer photocells, with a fifty times augmented effect, have been applied for by myself and Siemens and Halske. As long as the patents have not been published, I cannot, for obvious reasons, tell what metal combinations I use in these new cells. The electrodes also differ in their arrangements from those already used by Grondahl and Schottky.

Application of these cells to the production of energy out of the sun's radiation seems to be possible, but of course this is a task which can be accomplished only step by step.

Aggregates of a larger number of cells connected with each other seems to be the direction of the next development. There are still many difficulties of manufacture and of circuiting to be overcome. Even if these problems are successfully solved, the direct production of sun-generated power will be able to go into competition with the methods of fuel-burning or waterpower only in tropical and sub-tropical climates, where a steady strong radiation exists.

The sensitivity of my cells is nearly the same as that of the human eye, the curves showing a value of only 10 per cent. less than that of the eye. The cells are peculiarly sensitive to color-differences and have a sufficiently large output of energy to be used for many purposes without amplification. We already have built up microscopes for metallurgical purposes, allowing an objective control, the ocular of the microscope being replaced by these cells.

The cells will probably be on sale within a month.

There are a large number of technical purposes and applications for them. We have succeeded already in transmitting phonograph records, working with infrared rays instead of with the usual disks. All sorts of signalling methods through dense fog are possible by these methods. Even infrared telephony over long range seems to be possible. This

seems to be a very promising way for signalling to ships in fog. The determination of the sun's position by flying machines going through clouds is another possibility.

One of Germany's biggest liners is going to be fitted with a new smoke and fire control on this principle, the air from various parts of the ship being pumped through a system of tubes and passing in front of such cells. When smoke passes before the cell, it sets off an alarm.

Another technical application should be of importance in steel-mills. Sheets of red-hot iron passing through the rollers radiate enough light to work these cells. The changing of direction of the rollers can therefore be worked automatically by them.

A large number of scientific applications are foreseen. We have already built microphotometers with their help. Another useful device will be an automatic recorder for determining the correct time of photographic exposures.

*Science News Letter, April 11, 1931*

## Electricity From Sunlight

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U. S. Bureau of Standards are among those who have made the most important contributions to the problem in America. Dr. Duhme and Prof. F. Schottky in Germany recently came very near to anticipating Dr. Lange in his success. The greater simplicity and effectiveness of Dr. Lange's invention appears to be due to his clearer understanding of the underlying phenomena.

Large scale power is what distinguishes present-day civilization from the past. The heat and light of prehistoric sunlight stored in coal or more recently in the water of lakes are the motive power of our large industries.

The new photocell developments promise an entirely new method of power production. The energy of the sun's rays streaming down ceaselessly day after day on the surface of the earth means an enormous waste of power. Dr. Lange has given a method which may prove successful in putting the sun to work for man throughout the future history of the world.



DR. BRUNO LANGE

*Of the Kaiser Wilhelm Institute, Berlin, who has discovered how to use silver selenide to increase the efficiency of the light-sensitive copper oxide cell more than fifty times.*

It is just possible the world is standing at a turning point in the evolution of civilization similar to that which followed the invention by James Watt of the steam engine. For coal is not only limited in amount. It is also an extremely inefficient vehicle for the sun's energy.

The power which can actually be used, for instance, in an incandescent lamp, is a small fraction of one per cent. of the total sunlight stored in part in the coal, whose burning at the generating station produces the electric current. Lange's invention promises to put a lot of the other 99 per cent. to use.

Serious problems will of course be raised by the fact that the supply of the sun-power will not be continuous. Whether these will be solved by some form of storage arrangement or by operating the photogenerators in conjunction with some other kind of generator cannot be said at present. The energy storage problem is closely linked with that of power sources.

Some \$25,000 per kilowatt is the estimate that Dr. Lange has made of the cost of installing the copper sandwich on a large scale as a means of trapping the power of sunlight. This at first seems impossibly large as a hydro-electric station can now be erected at a capital cost of \$100 to \$300 per kilowatt of capacity. A steam turbine plant using

coal is, of course, still cheaper to install but the running costs in labor, fuel and maintenance of equipment are much greater.

The hundredfold increase in efficiency by using silver selenide in place of copper oxide, however, appears to bring the cost within the economic range for competition in the power industry. Apart from this it is likely that further improvements in the form of the cell will be made. The idea is still in its infancy.

A square yard of copper oxide sandwich can produce several watts of energy in full sunlight, says Dr. Lange.

Using this as a basis for calculation it is easy to see that a large power station of 300,000 kilowatts would require an area of about one square mile of the silver selenide cells.

The device **does not** lose its efficiency with time, and can be used with very intense illumination. Presumably the solar generators would be erected where there is practically no rainfall. The active surface could be protected from weather influences tending to destroy it by covering it with suitable transparent, resistant coatings.

*Science News Letter, April 11, 1931*

the true chemical nature of this vitamin.

Vitamin D, the antirachitic factor found in cod liver oil and generated by sunshine or ultraviolet light acting on fats, is the only vitamin which is sure to be present in sufficient quantity in our daily food, in Dr. Eddy's opinion. Through the extensive development of irradiation of foods by ultraviolet light, it is being placed in many food products and one large baking company is about to introduce it into all of its bread.

Vitamin C, the lack of which causes scurvy, is most important in the formation of good teeth, Dr. Eddy explained. This vitamin is found in citrus fruit juices.

The ability of the human body to make another of the vitamins, known as A, out of the yellow coloring matter of plants, known as carotin, was called to the attention of the chemists by Dr. Eddy. He announced that he had just tested a British preparation of pure crystalline carotin and that this material substitutes for vitamin A in the diet. This rôle of carotin in connection with vitamin A was discovered by Dr. T. Moore of Cambridge, Drs. I. M. Heilbron and R. A. Morton of Liverpool, and Dr. Euler, a German chemist. Scientists have known that yellow plants, such as yellow corn, are better sources for vitamin A but it had not been demonstrated before that the body could manufacture vitamin A out of the yellow carotin, so named because it is the coloring matter in carrots.

Colds and other infections can be guarded against by sufficient vitamin A, Dr. Eddy explained, in telling of research by other investigators who found that insufficient amounts of this vitamin in the diet promoted throat infections, stomach troubles, lung and kidney disorders and even some kinds of deafness.

Whether vitamin G is really the food factor that cures and prevents pellagra, the poverty disease of human beings, was questioned in a paper by Drs. Samuel S. Gurin and Walter H. Eddy of Columbia University, New York City.

In experiments on rats they found that two kinds of diseases of the skin were present in their experimental animals. And in the rats that got adequate amounts of beef extract and yeast rich in vitamin G, a trouble similar to human pellagra appeared in spite of their good growth. The chemists suggested that there are really two diseases, one prevented by vitamin G and another that is not.

*Science News Letter, April 11, 1931*

#### CHEMISTRY-NUTRITION

## American Diet Lacks Vitamins Despite Nutrition Publicity

**M**ANY TYPICAL American diets are lacking in proper vitamins despite the fact that vitamins have been stressed in extensive advertising the past few years. Prof. Walter H. Eddy of Columbia University, New York, a leading authority on nutrition, warned in his paper presented to the American Chemical Society at their meeting in Indianapolis last week.

The antineuritic vitamin B is the food factor most likely to be neglected in the foods we eat today, Dr. Eddy said. Vitamin B occurs in the wheat embryo and lack of it causes the disease beriberi. An insufficiency of this vitamin has been found by other investigators to

cause gastrointestinal disturbances.

"We must not be lulled by a sense of security with regard to this and other vitamins," Dr. Eddy said in explaining that investigations of typical American diets showed that they could be improved greatly by doubling the amount of vitamin B in them. Rats fed on a menu similar to that eaten by British working men grew twice as fast when a little wheat germ material was added.

Dr. Atherton Seidell of the National Institute of Health, told of the isolation of the antineuritic vitamin to such a degree of purity that it is more potent than any other preparation yet obtained. Even this research has not yet revealed

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