year that really satisfactory methods have been developed.

In the months immediately following the discovery of the scope of the South African deposits, it was freely predicted that within three years the union would be the leading platinum producer of the world. That this has not been more nearly realized is due chiefly to the unprecedented difficulties encountered in the treatment of these new ores. Decided progress has been made, however, particularly within the past year, and another year should show pretty definitely what is to be the status of South Africa in the world's platinum industry. In 1928 the production was 23,600 ounces of platinum metals from three treatment plants totaling 300 tons of ore per day; three more are under construction with a daily capacity of about 800 tons of ore, and this should provide a potential capacity of more than 100,000 ounces of platinum metals a year.

It still remains to be seen how much South African platinum the world can absorb, and at what prices. To secure a market for anything like the maximum capacity will mean strenuous competition against Russia and Colombia, and from increasing amounts of by-product metals from Canadian nickel ores. To accomplish this through a price war would mean the sacrifice of much or all of the profits of all producers for several years to come. The only alternative is international cooperative restriction of output at a stabilized price, and there seems little prospect of accomplishing this at the present time. It is possible, however, that the country that produced a diamond syndicate that has successfully maintained its existence for thirty years may find a solution of this similar, but possibly more difficult, problem.

One of the chief requirements for the future success of the industry is an increase in the present rather limited demand, by the development of new uses. Russia already has a platinum institute for the fostering of her industry, and Dr. Wagner advocates the appointment of a committee of scientific and commercial men for the same purpose in South Africa, the necessary funds to be supplied by the government and the mining companies controlling the industry.

The volume is concluded by an excellent bibliography of platinum covering the last twenty years. The entire volume is well printed, and is illustrated by thirty-seven figures in the text, and thirty-eight plates, three of which are geological maps of the Bushveld, Rustenburg and Potgietersrust districts. Typographical and other errors in the text might almost be said to be conspicuous by their absence.

GEORGE F. KUNZ

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN ELECTRIC KYMOGRAPH[1]

THE aluminum box shown in Fig. 1 contains four shafts. Shaft No. 1 is at the back of the box and extends only to the block opposite the disk on which the drum will rest. Shaft No. 2 is at the front and extends from the partition enclosing the motor all the way to the right-hand wall of the box. Shaft No. 3 is on the right-hand side at the back of the box, and shaft No. 4 is just in front of No. 3.

Above the shafts are seen two levers, pivoted at the back. The left-hand lever may readily be moved into any one of six slots on the middle portion of the front wall of the box, and the right-hand lever may as readily be placed in any one of three slots on the right-hand portion of the front wall. Each slot is double—a front and a back slot. And each slot is undercut on the right-hand side. In Fig. 1, the left-hand lever just mentioned lies free in the open part

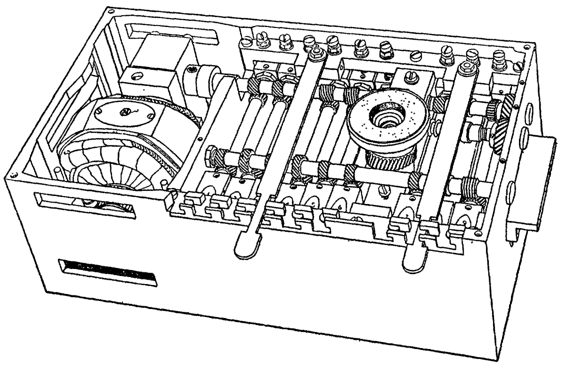

FIG. 1

of slot 4, whereas the right-hand lever is engaged beneath the overhang left by undercutting the middle one of its own group—the three right-hand slots. The left-hand lever in Fig. 1 can be lifted out of its slot directly, but the right-hand lever in Fig. 1 fits snugly in the undercut and must be moved to the left in order to free it. Obviously, the left-hand lever can be engaged in any one of its six slots and the right-hand lever can be engaged in any one of its three slots at the operator's will. Indeed, these levers may be moved from one slot to another in one or two seconds.

[1] This new kymograph was first given "public use" by Professor Charles W. Greene in his laboratory at the University of Missouri, Columbia, Missouri, January, 1929. The kymograph was formally demonstrated to the members of the Thirteenth International Physiological Congress in Boston, Wednesday, August 21, 1929. It will be found on page 37 of the official program under the title "An Electric Kymograph, by W. T. Porter."

At the back of each pair of slots, beneath the overhang, is the round head of a metal pin. When either one of the two levers is moved to the right and so is pushed beneath the overhang of a slot, the lever necessarily presses on the top of this pin, forcing it downwards. This pin in turn presses on an adjustable pin in a rocker arm, one of which is shown in Fig. 2. There is a rocker for each slot. When the

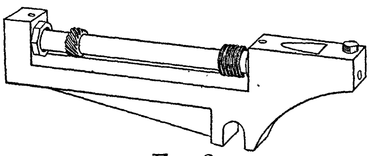

FIG. 2

pin is pressed down the rocker tilts up and its two gears engage with gears upon shafts No. 1 and No. 3. The group of six rockers (left hand) engages with shaft No. 1, and the group of three (right hand) engages with shaft No. 3. The large group (six) is controlled by the left-hand lever, and the small group (three) is controlled by the right-hand lever.

Let us now start the motor and thus cause shaft No. 1 to revolve. By engaging the left-hand lever in any one of its six slots, shaft No. 2 will also revolve. The gears on each of the six rocker arms governed by this lever are so related to the gears of shafts No. 1 and No. 2 that shaft No. 2 may revolve at six different speeds, the fastest when the lever is engaged in the left-hand slot.

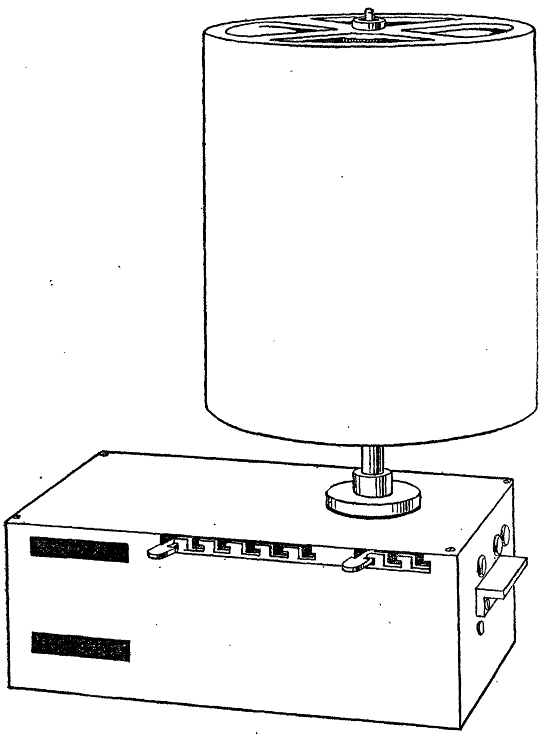

FIG. 3

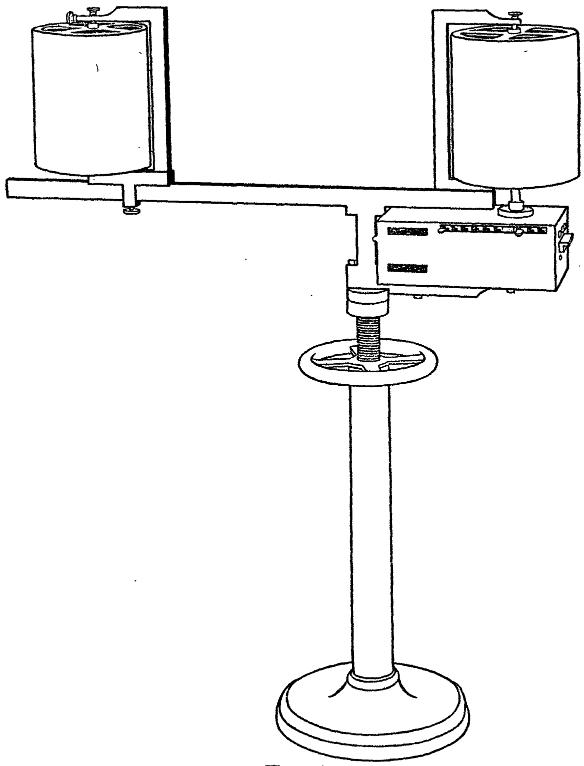

FIG. 4

So we have caused shaft 2 to revolve at any one of six speeds. Meanwhile, the smoked drum is unmoved. It does not turn until the revolutions of shaft No. 2 are carried to shaft No. 3, and thus to shaft No. 4, which last turns the disk on which the drum rests. But the six different speeds of shaft No. 2 are either increased or diminished in their passage to shaft No. 3. When the right-hand lever is engaged in its middle slot (as in Fig. 1), a gear of the middle rocker arm connects with a gear on shaft No. 3 in such a way as to produce a medium set of speeds; when engaged in the left-hand slot, fast speeds will result; and by putting the right-hand lever in its right-hand slot, slow speeds may be had. In each set (fast, medium and slow) there will be six possible changes, one for each position of the left-hand lever. The operator has therefore a choice of eighteen speeds. With a motor giving 1,725 revolutions per minute, these eighteen speeds are as follows:

FAST AND MEDIUM SPEEDS
In millimeters per second

Fast	100	75	50	30	20	10
Medium	10	7.5	5	3	2	1

SLOW SPEEDS
In centimeters per hour

Slow	50	38	25	15	10	5

When the clockwork is used to drive one drum only (Fig. 3), the slowest speed is one revolution in fourteen hours. When two drums are used (Fig. 4), connected by a paper belt about 2.6 meters long, the slowest speed is one revolution in about fifty-two hours. Naturally, the speeds vary with the motor used. The cylinders are 25 cm high and 70 cm in circumference.

As stated above, disengaging the right lever stops the drum, which may then be turned to right or left in order to inspect the tracing or adjust the recording instruments.

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SPECIAL ARTICLES

A POSSIBLE RELATION BETWEEN NATURAL (EARTH) RADIATION AND GENE MUTATIONS[1]

THE discovery three years ago that X-rays and radium produce gene mutations under laboratory conditions has raised the question of how mutations in nature occur.

Muller,[2] Olson and Lewis,[3] Haldane[4] and others have suggested that possibly radiations from the earth, or even cosmic rays, may have played an important rôle in the evolution of species by furnishing heritable variations upon which natural selection may act. It is not improbable that in earlier times radioactive substances were distributed over the earth rather differently than they are to-day and may have been more powerful, as evidenced by the quantity of their end products, helium and lead, now present in the earth. Joly[5] has suggested that cosmic rays may change in intensity and infers that we may be now at the low ebb of a cycle of cosmic radiation. He ties up this decrease of cosmic radiation with the increase of cancer in recent times. Haldane[4] says that "mutants are produced in large quantities by X-rays, and it may be that much of normal mutation is due to the beta and gamma rays from potassium, other radioactive substances and cosmic radiations."

Olson and Lewis[3] were among the first to point out the desirability of testing experimentally the effects of natural radiation upon organisms. According to them, the rays are effective only when absorbed with resulting ionization. Hence the biological effects will be in proportion to the amount of ionization they set up. The above suggestions inspired at least two geneticists to put the matter to an experimental test.

Working independently, Babcock and Collins[6] and the present writers performed almost identical experiments to test this point. Using an electroscope Babcock and Collins discovered a location in a street-car tunnel in San Francisco where the natural ionizing radiation was fully twice as great as the radiation in their laboratory in Berkeley. Accordingly their experiment was designed to compare the rates of occurrence of sex-linked lethal mutations in *Drosophila* in the street-car tunnel and in the laboratory. Three thousand four hundred and eighty-one tests were made in Berkeley, and nine, or 0.26 per cent., produced no male flies and hence showed the occurrence of that many new lethals. Two thousand five hundred tests made in the tunnel gave thirteen, or 0.52 per cent., of lethal mutations. While the difference in rate, 2.5 times the probable error, is not fully significant statistically, it is believed by these authors that it may be fairly so considered. Upon a reanalysis of the data showing the actual experimental variation in rate in the several subgroups in each of the two series it was found that the difference between the average rates for the two locations was increased. This difference was 0.275 ± 0.086.

The present writers, in accepting the implied challenge to experiment contained in Olson and Lewis's paper, considered themselves suitably located for such an undertaking, *i.e.*, near the Ozark caves and lead mines of Missouri. But a long search with the electroscope in the numerous caves and lead mines of this region failed to reveal a location with a sufficient increase of ionization over that of the laboratory, or the middle of a Missouri corn-field, to justify breeding experiments.

Operations were then transferred to Colorado. There in the East Paradox Valley of western Colorado in an abandoned carnotite mine the air was strongly ionized. In addition to the electroscope readings a rough attempt was made to compare the

1 The expenses of this investigation were met in part by a grant from the committee on the effects of radiation upon living organisms of the National Research Council.

2 H. J. Muller, "The Problem of Gene Modification," *Verhandlungen des V. Internationalen Kongress für Vererbungswissenschaft*, Berlin, 1928, pp. 234–260.

3 A. R. Olson and G. N. Lewis, "Natural Radioactivity and the Origin of Species," *Nature*, 121: 673–674, 1928.

4 J. B. S. Haldane, "The Species Problem in the Light of Genetics," *Nature*, 124: 514–516, 1929.

5 J. Joly, "Cosmic Rays and Cancer," *Nature*, 124: 579, 1929.

6 E. B. Babcock and J. L. Collins, "Natural Ionizing Radiation and the Rate of Mutation," *Nature*, 124: 227–228, 1929.