tions of the proceedings of some society whose meetings are held one year but whose publication is not accomplished until the following year. Furthermore, some bound volumes of periodicals cover publications of two years, or the last half of one year and the first half of the succeeding one. Accuracy and clearness become serious problems in the textual citing of such references according to the name-date system. In comparison with that system the numerical system has the advantage of being concise, accurate, definite and less expensive, and the numbers are easily inserted, inconspicuous, and their use in a small space does not distract the reader's attention from the subject-matter of the text. These advantages become especially evident in a paper containing many references to the same citation. Finally, the use of the numerical system permits the inclusion in the text of whatever names and dates are required.

An objection that is sometimes raised against the numerical system is that after a manuscript has been prepared, particularly when it reaches the galley-proof stage, the author finds another reference which he very much desires to add. If the name of the author of the new reference happens to begin with W or Y there may not be much difficulty in making the insertion, but if it unfortunately begins with A or B there may be trouble, especially if the list is long. An easy solution for this difficulty is to designate the new reference by a numbered letter. Thus if the previous citation in the alphabetical list is number 3, the inserted one may become 3a without any serious disturbance. If the list is not arranged alphabetically, and of course that arrangement is not a positive necessity when numbers are used, the insertion of new references could easily be made at the end of the list and numbers assigned accordingly.

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SCIENTIFIC BOOKS

The Platinum Deposits and Mines of South Africa. By DR. PERCY A. WAGNER. Oliver and Boyd, Edinburgh. 38 full-page plates, 3 maps, 37 text illustrations. 326 pp. Price 21s.

WHILE this volume discusses primarily the deposits of the Transvaal, it also includes those of the Cape Province and southern Rhodesia, which are closely related geologically with those of the Transvaal. The South African deposits have been much in the limelight since their discovery about four years ago, and this detailed exposition of the local situation by one so thoroughly versed in it will be welcomed by all interested in the subject. The story as related by Dr. Wagner is a marked tribute to Dr. Hans Merensky for the ability he displayed in opening up the new field, for he not only discovered both the dunite deposits and the Merensky Horizon in the Lydenburg district, as well as the more important locations in the Potgietersrust area, but also succeeded in locating the Merensky Horizon in the Rustenburg district after others had abandoned all hope of finding it.

It is with keenest regret that I have learned of the death of Dr. Percy A. Wagner, who was stricken with typhoid fever and died on November 11, 1929. He was one of the most talented men who has ever visited the great southern part of South Africa, and had just entered into a contract for five years to do mineral surveying, after having been director of the survey and doing much original work.

Dr. Wagner first discusses the sources of supply, the properties and uses, and the range of prices of the platinum metals. Several years ago some of the gold mines of the Rand developed methods of saving the small amounts of osmiridium that occur in these ores, and soon brought the union into the position of leading producer of this rare combination of metals. A few years later, the platinum deposits were discovered, and since the beginning of the industry in 1925 South Africa has reached third place as a producer of platinum group metals, being exceeded only by Russia and Colombia. For a number of years Canada has been producing a gradually increasing amount of the platinum metals as a by-product in the treatment of nickel ores, but yielded third place to South Africa in 1927.

Before the discoveries in South Africa, the occurrence of platinum was considered to be standardized as an alluvial product. While some was obtained as a by-product in the treatment of the ores metals, particularly nickel and copper, none was regularly obtained from ore mined *in situ* for the sake of its platinum content. As found in nature, the metal was seldom in the pure state, but usually occurred as an alloy of platinum with other metals of the platinum group and with iron; sometimes these were accompanied by gold, copper, nickel or cobalt. With the exception of these native alloys, only two minerals of the platinum metals were known: sperrylite, the arsenide of platinum, and laurite, the sulphide of ruthenium and osmium, and both of these were very rare. The former was found in the Canadian nickel ores and the latter in the platinum-bearing gravels of Borneo. In South Africa, then, for the first time, ores were found *in situ* in which platinum was found

in sufficient quantity to justify treatment for the recovery of the platinum content. These ores have not only given us our first extensive treatment of lode ores for platinum but have also contributed several items of more than ordinary interest in the mineralogical history of the metal. In addition to the native alloy minerals present in the ores, they contain platinum and palladium in a colloidal state, as well as various compound minerals. These ores have not only yielded single crystals of sperrylite up to 33.75 grams in weight (several hundred times larger than any previously known), but have also given us two new minerals: cooperite, a sulph-arsenide of platinum, Pt (As, S)$_2$, and stibiopalladinite, a palladium antimonide, Pd_3Sb. The ores of the Potgietersrust district are particularly rich in these compound minerals, while those from Lydenburg and Waterberg show mainly the alloy minerals. The presence of these colloidal metals and new minerals introduced new and difficult problems into the ore dressing and metallurgical treatment of the ores and are largely responsible for the delay that has been encountered in the development of the industry.

These South African platinum deposits present a unique chapter in economic geology, from every angle from which they may be viewed: chemically, mineralogically, geologically and geographically. The metals are found in both the free and the combined form and in association with both acid and basic rocks; they are found in all types of deposits: clays, sands, river gravels, marine beds, sandstones, quartzites, conglomerates and a variety of others; they are found in rocks of all ages, and in distribution they occur in a well-defined area reaching from the Insizwa Range in eastern Cape Province, north and east through the Black Reef, the Witwatersrand gold fields, the norite zone of the Bushveld Igneous Complex and the Waterberg district of the Transvaal, and on throughout the length of the Great Dyke of Southern Rhodesia, a total distance of about one thousand miles, giving what the author designates as "a great *platinum belt* that cuts indiscriminately across the oldest and youngest geological formations, completely disregarding geological structures and structure lines in the more superficial parts of the earth's crust."

The wide-spread occurrence of the platinum metals under such a variety of conditions is clearly a result of an underlying cause that has continued to operate throughout the various stages of geological time. According to Suess, the *sima* zone, a thick peridotite shell underlying the upper layers of the continental crust, is the principal home of the platinum metals. This would indicate that the *sima* zone underlying this portion of South Africa is abnormally rich in platinum which has been transferred to the surface layers of the crust. According to Spurr's conception of "ore canals" there should be here a great platinum canal that from earliest times has facilitated the upward transference of the platinum metals from the *sima* zone to the rocks of the overlying crust. Dr. Wagner predicts further discoveries of platinum along the course of this canal.

In the discussion of the less important sections of the platinum-bearing zone, three pages are devoted to the ultrabasic and basic rocks of the Swaziland system, nine pages to the Black Reef and the Rand, six pages to the Great Dyke, eleven pages to other minor sections and three pages to the eluvial and alluvial deposits; the bulk of the discussion, however, (165 pages) is concerned with the details of the deposits of the Bushveld Igneous Complex, associated with dunite, olivine, olivine-dunite, chromitite, magmatic nickel-copper-iron sulphides and particularly with the norites of the Merensky Horizon.

From a purely scientific standpoint, one of the most interesting sections of the book is the chapter contributed by Dr. H. Schneiderhöhn, of Freiberg, on the mineragraphy, spectrography and genesis of the Bushveld ores. This includes a study of eleven specimens from the Rustenburg district, seventeen specimens from Lydenburg and sixty-five specimens from Potgietersrust; mineragraphical observations on the occurrence of the platinum metals in the nickel-pyrrhotite-bearing rocks of the Bushveld Complex; a detailed description of the mineragraphy of sperrylite and the two new minerals, cooperite and stibiopalladinite; an account of the examination of various specimens for the platinum metals by the quartz spectrograph and ultra-violet light, and a summary of results and conclusions as to the genesis of the ores.

According to Dr. Schneiderhöhn these ores have passed through four phases in their formation: first, the earliest crystallization from the magma of such minerals as chromite, magnetite, etc.; second, the separation of the liquid sulphide melt from the silicate-oxide melt, and the crystallization of the sulphides; third, the crystallization of the residual solutions, and fourth, liquid exsolution-segregation and pegmatite formation. During the second of these stages the platinum metals entered into the crystal lattices of the iron-nickel sulphides and crystallized with them; during the third stage the temperature was too low to permit this, and the platinum metals were forced to crystallize separately, as sperrylite, cooperite and stibiopalladinite.

The problems involved in the mining of these deposits were soon solved, but the difficulties in ore dressing and metallurgical treatment were not so readily disposed of, and it is only within the last

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

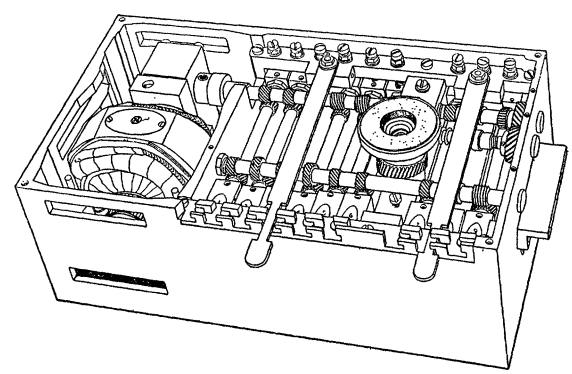

FIG. 1

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."