

Physics

South of the Sahara

By S. A. Korff

WE are sometimes inclined to think of Africa south of the Sahara as a country covered by tropical jungle and inhabited chiefly by elephants and pygmies. Any such oversimplification would lead us to conclude that this region had no interest for the world of physics. It is the purpose of this article to review (a) what is currently being done in physics and allied sciences and (b) the potentials for research and facilities which could be used by anyone having problems which could logically be undertaken there.

Probably the leading research organization doing work touching upon various branches of modern physics is the Bernard Price Institute of Geophysics at the Witwatersrand University at Johannesburg. Located in the largest city in the virtually independent Union of South Africa, the Price Institute has been built up to a position of importance under the aegis of Professor Schonland, now Deputy Director of Atomic Research in England. The reader will recall that Schonland's name appears on a substantial series of papers dealing with physics of the atmosphere.

Research now in progress at the Price Institute includes a set of seismographs, located at several stations, engaged in measuring ordinary seismic activity plus tremors produced by cave-ins in the extensive mine diggings which underlie the entire area. Ingenious electric timing devices have been worked out, and data is recorded on automatic registration-tapes which become activated when one of the instruments receives an impulse from a tremor. These tremors are used to replace explosions and natural earthquakes in the study of the layering of the earth's crust. Equipment on hand also includes counters and mass spectrometers for analysis of radioactive ores, many of which appear as by-products in the local mines, as well as tracer research of use to local industries. Perhaps of greatest interest to

physicists is a newly developed technique of measuring the properties of lightning flashes inside clouds by the use of radar. Since the radar echo determines both the angle and the distance along the line-of-sight, absolute location of the origin of the echo is possible. Further, the fast repetition-rate permits one to follow the evolutions of the flash. One can thus determine both the velocities of the leader and main strokes, and the rate at which the charges dissipate by recombination after the main discharge. This research has thrown much new light on the mechanism of the lightning flash.

The Institute also has a group engaged in a determination of the ages of pre-Cambrian rocks by the rubidium-strontium decay method using mass spectrometers and isotope dilution (spiking) techniques, and another group working on rock magnetism.

In Kampala, in the British Protectorate of Uganda located on the northern shore of Lake Victoria, the world's second largest body of fresh water, is Makerere College. The College is affiliated with the University College of London, England, and is called the University College of East Africa. Examinations are common to both institutions, and a student may transfer from one to the other in corresponding grades without loss of credits. The College is located on a hill on the northern edge of the town. The altitude is about 3800 feet, and adequate electric power is available. Physics and chemistry share a two-story building, which also houses a machine shop, lecture rooms, laboratories of instruction, and some rooms in which physics research is now burgeoning. The majority of the students are Africans, with a few Asians and comparatively few Europeans. The chairman of the department is Professor J. P. Andrews. Professor D. M. Thomson, formerly of Cambridge (England) and Princeton, is initiating a cosmic-ray program, starting with photographic emulsions and planning in due course to build some circuits for counter-arrays also.

In the Belgian Congo, some 300 miles south and west

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of Kampala, the Belgian Government maintains an organization called IRSAC (Institut pour la Recherche Scientifique en Afrique Centrale), one branch of which is located on the hills above Lake Kivu, about 25 miles north of Bukavu (formerly Costermansville). The lake, one of the chain of lakes in the Albutine rift, has an altitude of 4760 feet, and the IRSAC buildings lie on a slope at about 5500 feet, with the uppermost ones at about 6500. The Institute concerns itself mainly with the problems directly applicable to the region, and hence its main departments are medical (study of local diseases), entomological (tse-tse fly control and allied problems), physiological, nutritional, and the study of crops and minerals. The branches of physics represented include geophysics, seismology, and soil physics, as tropical Africa has a serious problem of laterites as well as advanced erosion in many places. Some thought has been given to establishing a cosmic-ray recording station. The present installation has a considerable staff of research men of various grades, a fine climate and a magnificent situation amid California-like scenery. Providing an interesting diversion for the scientists, the upper farm of the IRSAC station is frequently visited by elephants, whose spoor only a few hours old was on the ground at the time of our visit. The Institute is ably directed by Dr. Louis Van den Beighe, the physics section being headed by Dr. Jean De Braemacker, a well-known geophysicist. Dr. James P. Chapin, Curator Emeritus of the American Museum of Natural History and the world's outstanding authority on the birds of Central Africa, is there on a prolonged visit completing his book on this subject.

Further, the INEAC (Inst. Nat. d'Études Agronomiques au Congo) has a laboratory studying soil physics at Yangambi, and the Meteorological Department at Leopoldville has a branch making geophysical studies. This Department has also conducted extensive and well-considered studies of solar radiation, and is considering a cosmic-ray program. Ionospheric transmitters are located at several places in the Congo and new ones are being built today.

Five well-known astronomical observatories are located in the Union: the Lamont-Hussey Observatory of the University of Michigan at Bloemfontein, altitude 4900 feet; the Boyden Station of Harvard, also at Bloemfontein; the Union and Yale Observatories at Johannesburg, altitude about 5900 feet; and the Radcliffe Observatory at Pretoria, altitude 5060 feet. These we cite only to indicate that astronomy also is not a neglected subject in South Africa, and that the facilities required for substantial work in astronomy and astrophysics exist. Physics departments at the Universities of Stellenbosch and Potchefstroom are also doing research of note.

TURNING next to a consideration of possible facilities which might, for example, be of use to cosmic-ray physicists, we have the following situation. Many of the towns in the East African highlands are at altitudes of three to six thousand feet. Thus, Johan-

nesburg is at almost 6000 feet, Bulawayo in Southern Rhodesia is 4400 feet, and Nairobi in Kenya is at 5500 feet. The geomagnetic equator lies north of the geographic equator in this region. In East Africa to obtain the south geomagnetic latitude one adds about 3 degrees to the south geographic latitude, thus making Nairobi 5°S geomagnetic, Kampala 3°S, Bulawayo 23°S and Johannesburg 29°S.

For really high altitudes, undoubtedly the best opportunity is offered by Kilimanjaro. Not only is this Africa's highest peak, 19 565 feet according to the latest survey, but from the point of access it is the easiest. Kilimanjaro is at 3°S geographic, longitude 37.5° east, geomagnetic latitude 6°S. There are other peaks, Mt. Kenya, 17 040 feet, and the Ruwenzori, at 16 700 feet, but the former is a harder climb than Kilimanjaro and is in the presently troublesome Mau-Mau area, while the Ruwenzori are heavily snow-covered and most of the time have their summits covered by clouds. Kilimanjaro is in Tanganyika Territory, a British-administered trusteeship territory. Its base is reached by rail or auto road. The railway attains an altitude of 2700 feet at Moshi, and connects with the Nairobi-Mombasa line, also reaching the coast at Tanga. By auto road one can get to several plantations at about 7000 feet, where the climb on foot starts. The mountain is not technically difficult, but does involve long uphill walks at high altitudes. Native porters are obtainable but do not have the experience of the Himalayan Sherpas. Huts for overnight shelter exist at about 15 800 feet. The mountain is an old volcano with two separate summits, Kibo and Mawenzi, separated by some seven miles. In point of fact the Kibo hut is visible from the Mawenzi hut, so that a 6-mile base-line is available. The two huts are at roughly the same altitude. As there is no electric power available above the 5000 to 7000-foot level of the plantations, experiments on top presuppose equipment requiring little or no power such as recording electroscopes or plates. The summit is snow-covered at all seasons, and is always fairly cold, say, zero to -20°C, and has least snow in the dry season of May to September. The peak has been climbed numerous times, and plans are at present under consideration to expose nuclear plates there.

Of other peaks there is not a wide choice until one comes down to the 10 000 to 11 000-foot altitude, at which level one can find peaks in the Belgian Congo, in French Equatorial Africa, in Morocco, and elsewhere. Roads in general do not go much above 7000 feet. Towns are mostly below 7000 feet, and power is available at various plantations up to, but seldom above, this altitude. One exception exists in the case of the town of Timboroa, about 120 miles northwest of Nairobi in Kenya. Here the Nairobi-Uganda railway crosses a pass at 9496 feet, between the larger towns of Nakuru and Eldoret. Professor Clay and his associates from Amsterdam occupied this site several years ago, but there is nothing being done there at present, and except for a building and a small amount of electric power, everything would have to be brought.