During the last thirty years the greater part of Professor J. Clay's activity in physics has been devoted to cosmic-ray research. A full account of his contributions to this comparatively young branch of physics can only be given in connection with the story of cosmic-ray physics from Victor Hess's discovery down to the present times. Yet his work may be regarded as complete in itself to such an extent as to justify an attempt to let its picture stand by itself and be the reflection of the development of an entire era.

Because of their remarkable penetrating power, cosmic rays were at first supposed to consist of electromagnetic radiations rather similar to X-rays but of much shorter wavelengths and accordingly stronger penetration. Opposed to this line of thought advocated by the American scientist Robert A. Millikan was the corpuscular concept according to which the radiation was composed of charged particles. Much discussion took place before this fundamental point was finally cleared up by the historic voyages of 1927 and subsequent years between the East Indies and Europe, and indeed even after. In the course of these voyages, Clay proved that the intensity of cosmic radiation at sea level between Genoa and Batavia varied according to the geomagnetic latitude, its value being smallest at the geomagnetic equator. Although his observation of the interaction of the geomagnetic field with cosmic-ray particles provided conclusive evidence that they carried an electric charge, it was quite a time before his results were generally accepted, partly because it was at the time extremely difficult to take accurate long-term measurements, and partly for non-physical reasons.

Subsequent expeditions to equatorial regions, the southern hemisphere and the fjords of Norway completed the picture of the latitude effect of the two components into which the radiation could be divided, the soft component that only penetrated a few inches of lead, and the hard component that penetrated many feet and more. As the absorption suffered by the particles of the hard component in
the earth's crust or in sea-water results in stopping the particles of low
energies and in sorting out those of high energies, an accurate deter-
mination of the numbers of particles present below various layers of
water or rock provides a means for determining their energy distri-
bution. During the period before World War II, Clay collected an
enormous amount of data on the penetrating component, measuring
its absorption in water down to 1450 ft below sea level, and in the
ccoal mines of Dutch Limburg down to 2020 ft. Only quite recently,
the energy distribution of the soft component has also been the sub-
ject of precise measurements and theoretical computations in the
Amsterdam laboratory, so that a twenty-years' systematic program has
now been brought to its conclusion.

The investigation of cosmic radiation is much complicated by
the process of multiplication. During the interaction of cosmic rays
with the atomic nuclei of the material they pass through new rays
are created, both electromagnetic and corpuscular. These new rays
are capable of giving rise to new multiplication processes, so that
one incident particle can be the origin of an enormous shower. The
structure of showers developed in the atmosphere or in layers of lead
or other materials has had Clay's indefatigable attention. Among
his most spectacular results is the geometrical relation of penetrating
and soft electronic particles in one extensive shower. According to
this, the penetrating particles must be thought of as constituting
the trunk and heavy branches of the shower tree, with the soft
particles arranged around them in the way of twigs.

Yet another important discovery was the existence of very dense
and extensive showers of rare occurrence in which particle densities
as high as one million per square meter were found. In the instru-
ments used by Clay, such extremely dense concentrations of cosmic-
ray particles were only observed once or twice a year, and their
reality could only be established after years and years of continuous
registration.

Registrations have unintermittently been carried on by Clay and
his coworkers in view of the ever-impending problem of the origin of
the radiation. Variations with local or siderial time have not been
found within the accuracy of the measurements. A highly significant
correlation could however be established between certain small but
sudden variations of cosmic-ray intensity and the occurrence of solar
flares. This effect was first recognized in observations made in 1946
at Amsterdam and at various other points of the earth. After ap-
proximately twenty-four hours, these flares are followed by magnetic
storms, which in their turn influence the intensity of cosmic radiation