yet to be supplied. The following method has been devised to meet these difficulties:

A condenser of considerable capacity is first connected to the lighting mains and charged at 220 volts. It is then disconnected and discharged through the primary coil. The charging and discharging of the condensers is effected by means of a commutator. In this way the only current passing through the coil is from the condenser. The commutator is on the shaft of a small fan motor.

A six-inch Ritchie coil connected in this way with a condenser of 25 microfarads, its own condenser being disconnected, gives a thick fuzzy spark about two inches long. Removing the primary of the coil and replacing it by about seventy turns of rather heavy wire, number 8 or 6 B. & S., we get a multitude of fine zig-zag sparks about six inches long, the discharge being identical in appearance with that from an induction worked in the ordinary manner under the best conditions. The introduction of iron, unless finely laminated, cuts down the discharge to about one-tenth its value. Increasing the speed of the charge and discharge of the condenser up to about 2,000 per minute, which is the limit of the very crude commutator at present employed, improves the discharge of the coil in quantity and voltage. The sparking on the commutator is very slight, and the amount of power taken from the mains is small.

The discharge obtained in this way, so far as we can now judge, seems well suited for driving X-ray tubes. Tubes so driven give a brilliant fluorescent screen with strong sharp shadows. An exposure of twenty seconds gives a good photograph of the hand.

Chas. L. Norton,
Ralph R. Lawrence.

Rogers Laboratory of Physics,
Mass. Institute of Technology,
Boston, February 17, 1897.

CURRENT NOTES ON PHYSIOGRAPHY.

THE COLORADO PLAINS.

An essay by Gilbert on the 'Underground Water of the Arkansas Valley in Eastern Colorado' (17th Ann. Rep. U. S. Geol. Surv.) affords more specific information as to the topographic features of the plains and their origin than is usually obtainable from older reports. The general surface of the plains does not accord with the surface of their uppermost stratum, but bevels across the strata at a faint angle. The plains are therefore not in topographic youth, but in topographic old age, the result of a cycle of denudation during a lower stand of the land. On the peneplain thus formed there are now strewn the 'upland sands,' pebbly, cross-bedded, 50 to 200 feet thick; the pebbles being derived from the mountains on the west. This implies a period of aggradation, after the long preceding degradation. In explanation of the change it is suggested that the region may have been raised in the east or depressed in the west so as to lessen the slope of the rivers; to this there may be added a possible uplift of the mountains alone by which the load of the rivers would have been increased. To-day the sand-strewn peneplain is trenched by broad valleys, that of the Arkansas being fifteen or more miles wide and 400 to 800 feet deep. Successive pauses in the work of valley-cutting produced broad straths at lower and lower levels, whose remnants are now seen in gravel-covered terraces, the seat of much irrigated land. The eastward slope of the terraces is greater than that of the present grade of the river; hence a progressive uplift is argued during the excavation of the valley. The upland sands and the stream beds at low water supply sand to the northwest winds and extensive patches of dunes are thus formed, a system of hills and hollows without drainage by streams. The relation of Cretaceous strata, upland sands

and dunes to ground and underground water is fully discussed.

THE PREGLACIAL KANAWHA.

THE effect of drift obstructions in altering the courses of rivers in western Pennsylvania and eastern Ohio has been recognized for a number of years, the northward discharge to Lake Erie having been thereby greatly decreased. The diversion of the Missouri from a northward discharge to its present membership in the Mississippi system is also credited to glacial obstruction, and the important service of the great western river as a guide to western exploration, early and late, on our side of the Canadian boundary may, therefore, be credited, along with the water powers of New England, to the glacial period. Still another example of this kind is noted in the 17th Annual Report of the Geological Survey, in which the Director mentions a discovery by F. Leverett, with reference to the ancient drainage of the Virginias. The Kanawha, uniting with other streams in the western part of West Virginia and eastern Kentucky, ran in preglacial time northward towards Lake Erie, along a line partly coincident with the course of the south-flowing Scioto of to-day. This makes the preglacial drainage of the St. Lawrence include headwaters in North Carolina. The existing Ohio can, therefore, no longer be interpretated as of ancient origin, as if still flowing along a consequent course between paleozoic uplifts on the north and southeast. It is a composite stream of postglacial date. As a glacial product, it has been of even greater service than the Missouri, for our early settlers in its fertile lower valley took great advantage of its well-graded course, along which their advance was much easier than if they had had to go up and down hill, across the grain of various north-flowing rivers.*

*Some of my correspondents have pointed out that a suggestion regarding the origin of Teay valley (SCIENCE, II., 1895, 40) independent of the Kanawha, is inadmissible; for the valley contains gravels that could only have come from the upper Kanawha. Its origin by Big Coal river, therefore, seems out of the question.

THE RIVERS OF SAGINAW BAY.

A NUMBER of years ago Gilbert described the course of the Maumee river in northern Ohio, showing that its peculiar back-handed branches were consequent upon the faint relief determined by moraines and glacial lake beaches. A recent essay by Taylor (Correlation of Erie-Huron beaches with outlets and moraines in southeastern Michigan, Bull. Geol. Soc. Amer., VIII., 1897, 31–58) now gives another example of a very similar kind and warrants the recognition of these back-handed branches under some appropriate name, ready for convenient use when still other members of the class shall be discovered. Saginaw river, with its Cass and Tittibawasee arms, and swampy head opposite the upper course of Grand river, repeats the essential features of the Maumee to a nicety.

Back-handed branches resulting from the migration of divides quite independently of glacial constraint are easily distinguished from the class here considered. The barbed arrangement of the upper branches of the Maira recently diverted from the Inn on the watershed of the Alps are of this second class.

W. M. DAVIS.
HARVARD UNIVERSITY.

CURRENT NOTES ON METEOROLOGY.

CHALK-PLATE WEATHER MAPS.

ONE of the recent improvements in the methods used by our Weather Bureau deserves mention in these Notes. As is generally known, the daily weather maps issued from the various Weather Bureau stations over the country have for some years been reproduced by a stencil process which, although a good method, when carefully ex-