which they were more developed. In the nearly vertical nostril there is a peculiar arrangement. A fold reaching out from each side divides the opening into two, connected within, the upper of which looks forward, and, when moving ahead, catches the water, and turns it into the nasal cavity to pass over the membranes and escape by the lower aperture, which looks backward. Nictitating membranes are absent. The eyes are placed to look sidewise and downward. Above the anal fin, there is a small dorsal. The pectorals are of moderate size. Ventrals, anal, and caudal are large. From these fins, if it were not for lack of firmness toward the edges, one would conclude the animal was capable of great speed. However, taking into consideration the size of the branchial apertures — which allow the water entering the mouth free escape, whatever the rate of motion — and the position of the large fins, it seems as if the creature had the habit of bending the body and striking forward to to seize prey, as do the snakes. The broad fins, so far back on the body, secure a fulcrum from which to strike. At their margins the fins are very thin, and their extremities are produced in a sort of filament. The structure of the jaws and gill arches is such as to admit of swallowing a large object. At the same time the excessive sharpness of the teeth, and the smallness of the intestine, indicate that the prey is comparatively soft. The vertebrae and other cartilages are flexible, as those of the basking sharks Selache and Somniosus. A certain embryonic appearance in the specimen instigated a search among the fossils for allied species. Most resemblance was found in the teeth of Cladodus of the Devonian; but the cusps were erect instead of reclining, and the enamel was grooved or plicate instead of smooth. One is impressed by a study of this specimen with the idea, that, away back in times when Selachia and fishes were more alike, he would have a better chance to trace the affinities. The Bulletin of the Essex institute, vol. xvi., contains description and figures under the name Chlamydoselachus anguineus. I am inclined to consider this the type of a new order, to which the name Selachophichthyoidi might be given, and which stands nearer the true fishes than do the sharks proper. The shark was secured in Japan by Professor Ward, from whom it was purchased by the Museum of comparative zoölogy.

The sketch on the preceding page gives the entire outline, the upper and lower views of the head, and an upper view of one of the teeth.

S. GARMAN.

THE RUSSIAN METEOROLOGICAL SERVICE.

ALTHOUGH the idea that Russia is behind the other powers of Europe in civilization is true when we consider the people as a whole, yet, if we look at what has been done by the Russian government for the encouragement and advancement of science, it must be admitted that Russia plays a very important part in the total amount of scientific work accomplished by the world.

The Russians have the best astronomical observatory in the world: they have also the best meteorological observatory. The magnetical studies have been made in connection with the meteorological; and in the observations, as well as the theoretical discussions, we find the same men engaged, and the results are published side by side. In speaking of the meteorological work, one is forced, then, to at least mention the magnetical, on account of this close connection.

The Physical central observatory at St. Petersburg was founded in 1849 through the endeavors of Kupffer. The aim of this observatory was to institute physical observations and research in general, and to advance Russia in the line of physics; and, as part of the latter task, the conducting and publishing of meteorological and magnetical observations was undertaken.

So it will be seen that this observatory was not intended merely as a central office for a meteorological service; but it was to become a physical laboratory, where all sorts of physical investigations could be undertaken, and in such a manner that nothing more could be desired, that is, as far as apparatus and methods employed are concerned.

The first director, Kupffer, separated as much as possible the two departments of the observatory, as his publications show. His researches into the elasticity of metals, published in 1860, which were cut short by his death, show the nature of the purely physical investigations undertaken by him. He published an enormous mass of meteorological material in the *Annales de l'observatoire physique central*, 1847–64; also in the *Correspondance météorologique*, commenced in 1850.

In seven places hourly observations of the meteorological elements were instituted, and in six places of the magnetical elements. These and many of the observations from other stations, made a certain number of times a day, were published.

In speaking of this material, Professor Wild

said, "It is a complete mass of meteorological and magnetical observations published in detail, and therefore easily accessible to every one, and such as no other land possesses: it is of great value to the science; but it would have been much more valuable, yes, invaluable, if it was as satisfactory as comprehensive."

As at first organized, there were few under-officials in the observatory; and most of them were men who received small salaries, and were not especially qualified for their positions, — or, rather, there were no positions for men qualified, — so that the director was obliged to attend personally to all work requiring much thought. A force, then, of a director and five not specially prepared men was to conduct the work of the central office, from which were to be issued the meteorological observations, and their discussion, of a country five times as large as all the rest of Europe, through which about twenty separate meteorological institutes are distributed.

It is not to be wondered at, then, that Russian observations lay for so many years almost unused by their meteorologists. Any one who has attempted to work with magnetic observations knows that little can be done single-handed, especially if the person must also busy himself with the instruments themselves.

Through inability on the part of the director to cope thus single-handed with the great work undertaken, the meteorological service went gradually into decline. The separate stations could not be properly inspected to see that the instruments were correct, nor could the necessary attention be given to the preparation of the observations for publication. Matters finally came to such a pass, that about 1864 a re-organization of the service was agreed upon, and the establishment of forty new meteorological stations. However, the next year, and before any thing could be done, Kupffer died, and Kaemtz was called to succeed him.

This great meteorologist at once elaborated plans for the improvement and enlargement of the service; but a great undertaking of this kind goes forward slowly, and at his death, two years later, not much had been carried practically into effect.

The service, then, was in a disorganized condition when Wild took charge in 1868. Although it is probable that a great improvement would have taken place had Kaemtz lived, yet we can hardly hope that he would have placed the service in that high position which it now holds in reference to others, and which it assumed so shortly after the choosing of Wild as director.

Professor Wild doubled the corps of assistants, and made the positions so desirable and important that university men were glad to accept them, and good men from other continental countries were easily persuaded to accept places. These men were of such ability that they could undertake and successfully carry out, under the supervision of the director, any single investigations, and thus relieve the chief of that care and constant watchfulness which would have been necessary had he had less skilful assistants. The results of these labors can be seen in the papers published in the *Repertorium für meteorologie*.

But it is mainly of the Russian service as it at present exists, and especially of the meteorological observatory, that I wish to speak.

The whole establishment is composed of several observing-stations of the first order (i.e., where either hourly observations are made, or where self-registering barometers, etc., are employed), and about a hundred and thirty stations of the second and third orders, where observations are made at stated times during the day. In order to obtain an idea of the distribution of these stations, the reader must consult the chart accompanying the *Temperatur-verhältnisse des russischen reiches*, published in 1881 by the observatory.

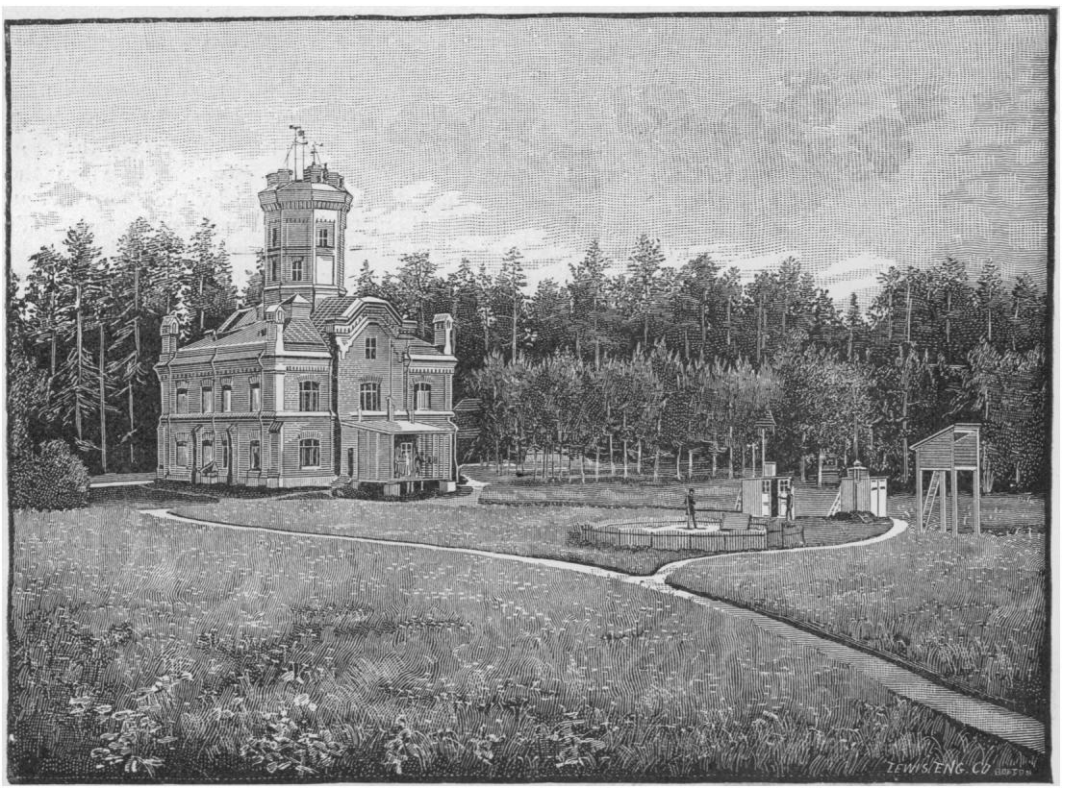
The meteorological observatory at St. Petersburg consists of two parts, — the Central physical observatory, in the city itself; and the observatory at Pawlowsk, in the country, about thirty kilometres distant. The present building occupied by the former was built about 1860, and continued to be the principal observing-station until 1877, when the other was grounded.

The building in St. Petersburg occupies a not prominent position at a little distance from the north bank of the Neva, in the western end of the city; but it has no longer the quiet surroundings that it probably had at the time of its construction, as the city is extending in that direction.

All of the work of standards, instrument-comparing, preparing matter for the printer, correspondence, supplying stations with necessities, and the general management of the whole service, is carried on here, and for eight or nine months of the year it is the dwelling-place of the director.

For the non-meteorologist, however, the only attractive feature of the institution is the large instrument saloon, where there is much fine apparatus, especially standards. The library is a very good one, and the numerous books in foreign languages show the extent to which the

Russians make use of foreign writings. In fact, very few of the books in the library are in the Russian, even when containing their own work. There is, however, a strong reaction in this respect; and before many years we may expect to receive the Russian scientific publications, not in the French and German languages, as at present, but in the Russian. This will be unfortunate for us; because the language is difficult to learn, and much of their science would be buried to us for a long time at least.



METEOROLOGICAL STATION AT PAWLOWSK, RUSSIA.

At Pawlowsk there is much of interest. It requires about an hour's time on the railway to go from St. Petersburg to this place. On the way there, the clump of trees surrounding the great Pulkowa astronomical observatory is visible; and in winter the main building itself can be plainly seen.

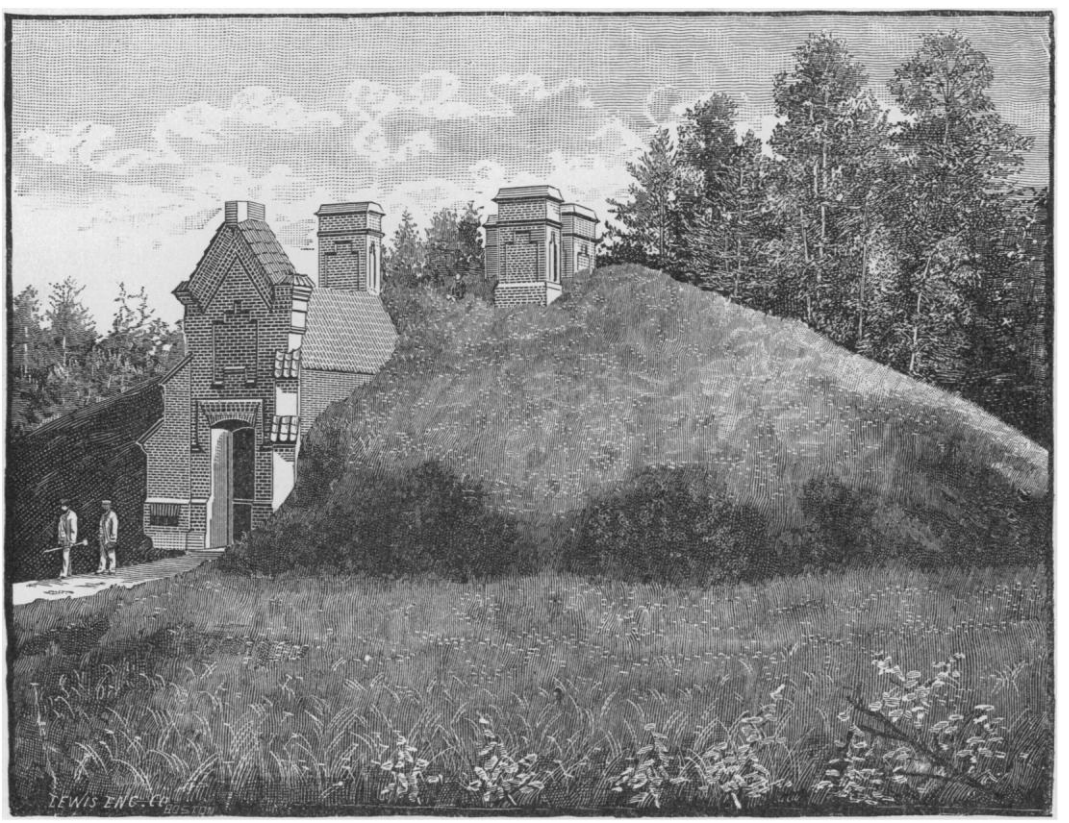
There were several reasons for the founding of this new observatory. Professor Wild had ideas that he wished to carry out, and which he considered essential for the best results: he had found the city observatory in a settled condition, and it would have been impossible to change it into such a form as he wanted. Again, the old observatory was a poor place for magnetic instruments, both on account of the unsteadiness of the instruments, and the close proximity to the iron ships that are constantly passing and repassing on the river, only a few hundred feet away. He also had the idea, which is shared by most meteorologists, that the city itself is no place to make meteorological observations; as the conditions are not the same as in the surrounding country.

This observatory is situated nearly two miles distant from the town of Pawlowsk, which lies thirty kilometres south-east of St. Petersburg. This town, although thinly inhabited in the winter-time, is filled to overflowing in the summer by the people from St. Petersburg, who want to enjoy what little summer country life they can find.

A small portion (several acres) of the park of the uncle of the present czar has been given for the purpose of the observatory, and this piece of ground has been fenced off and the buildings erected upon it. The land lies per-

fectly flat, and is mostly covered with fir trees; although, of course, part has been cleared, so as not to influence the readings of the instruments. The observatory is certainly the meteorological paradise (at least in summer); and the visitor, whether casual, or there for the purpose of study, cannot but be struck by the taste which has been displayed in its organization and construction. The whole establishment was erected at a cost of about seventy-five thousand dollars.

The accompanying illustration shows the main building from the north side. The large thermometer-shelter is seen against the building; a little to the right, through the trees, is seen the stable; and still more to the right the roof of the director's summer residence is visible. Of the smaller buildings, the one to the right is a thermometer-screen; the other two for self-registering instruments, one containing a rain and wind measure, and the other a rain-measure and atmometer. There is also another rain-gauge, and the black bulb *in vacuo* near these. Inside of the little enclosure is a sand-heap in which are buried the thermometers for measuring the earth's temperature at different depths. The instruments are placed both in a vertical and horizontal position. In order to get at the horizontal thermometers, a hole has been dug, which contains a box filled with earth, the hole being covered by a trap-door. The box can be slid from its position, and the end of the thermometer-cases exposed to view. These are then drawn out (horizontally) by the observer, and read without taking them from the hole. The vertical thermometers are not in this hole, but are drawn vertically out of the sand when read. The glass tubing surrounding the thermometers is so made that no moisture can reach the thermometer-bulbs.



MAGNETIC OBSERVATORY AT PAWLOWSK, RUSSIA.

Near this sand-pile is a pond constructed for the purpose of making measures of evaporation on a large scale. The observations of this

kind are not, however, of a very satisfactory nature; and the pond has apparently returned to its legitimate use, viz., furnishing a home for about a million small fishes.

In no place in the world is so much attention paid to magnetic observations and investigations as here at Pawlowsk. We see in this cut the underground magnetic house, and its size can be seen by comparison with the figures in the foreground. The building consists of two chambers, separated and surrounded by air-chambers which are heated; and the heat is thus conveyed through the walls into the observing-rooms. These rooms remain at a wonderfully constant temperature. The building is quite isolated from the remaining portions of the observatory. It was here that the observations simultaneous with those of the recent international polar expeditions were made.

The whole work of this institution is scientific in the highest degree, and there is little of what we may call popular work done; but this is unnecessary, as those who would be influenced by a more evidently practical result have nothing to say in regard to the conduct of the service.

RED SKIES IN CHINA FIVE YEARS AGO.

THE 'red sunsets' which have recently attracted so much attention in so many quarters of the globe, and have called forth considerable discussion in various scientific journals, both in America and Europe, recall very similar phenomena I observed five years ago, under circumstances which seem to me worth recording at this time.

During the early part of the winter of 1878–79, I had occasion to pass several weeks, engaged in geological work, along the base and among the foot-hills of the first mountain range that rises above the plain of northern China, and forms the boundary between the provinces of Chihli and Shansi. Frequently in the month of November my attention had been called to the intense coloring of the sky, and brilliant red afterglows, slowly fading away, and lasting long after the sun had set. On one occasion, Dec. 1, I left the small mountain village of Cheang-Shui, accompanied by my friend Mr. W. N. Pethick of Tientsin, for a long tramp among the hills. We travelled up the long valley, and ascended to the top of the pass commanding an extended view to the westward, over the plateau of Shansi. Although late in the day, we pushed on to the village of Tang-Cheng-Tsun, a mile and a half to two miles beyond, reaching there about sunset.

On our way back to the pass, I was continually looking backward, astonished at the brilliancy of the sky, the orange-red and peculiar brick-red colors of the horizon, and the length of time the vivid coloring remained after the going-down of the sun. How long this intense afterglow continued I am unable to say; as, on reaching the summit, we retraced our steps down what in the Cordillera would be called the cañon, and the western view was completely lost behind an abrupt wall.

All the phenomena connected with the sunset were quite similar to those recently observed in New York, except, as I now recall the scene, the colors seemed to surpass them in brilliancy.

Through the month of December I was frequently impressed with the deep red glare of the skies, and long twilights, although none of them appeared to equal in intensity the one observed from the top of the plateau. This difference I supposed was due to the view being somewhat shut off by the high ridge to the westward.

As early as November the prevailing winds in northern China blow almost continuously from the north-west, across the broad area of country covered with loess-deposits. In consequence, the atmosphere was never wholly free from fine loess-dust; a haziness being at all times noticeable in the mountains, while frequently the air was gray from the large amount of impalpable dust held in suspension. On those days when the dust was most perceptible the colorings of the skies were never remarkable, and were only fine when the lower atmosphere seemed clear and bright.

These brilliant afterglows continued at intervals throughout December and early part of the new year; the last one being noticed about the middle of January, from a small village seventy-five miles east of the mountains, where I had put up for the night on my way to Tientsin. In the following September I again visited the mountains and plateau of Shansi, but do not recall any thing in connection with the sunsets at all comparable to those observed the preceding winter. But, on the other hand, the atmospheric conditions were also wholly changed; the wind was blowing steadily from the east or ocean side; the air was laden with moisture, which was frequently precipitated in heavy rains; and the atmosphere, so far as the eye could detect, was free from dust. I can but think that the great brilliancy and long duration of the afterglow were intimately connected with loess-dust in some such way