Rev. Moses Harvey of St. John's, Newfoundland, and a new fellow of the society, contributed a most important paper "On the Artificial Propagation of Marine Food-Fishes and Edible Crustaceans." This paper deals extensively with the rise and progress of pisciculture, the importance of modern fish-culture, artificial increase of fresh-water and anadromous fishes, also the results obtained by private and national enterprises. Aqui-culture may yet approach agriculture in usefulness. Scientific study of fish-life and the physics of the sea bore intimately on the value of fisheries. The work carried on by the United States Fish Commission, by the Canadian Department of Fisheries, and the success of Norwegian pisciculture, along with the great results already obtained by lobster hatching with the Nielson process, are all discussed by Dr. Harvey, and many important facts of great economic value are noted. The paper ends by calling attention to the need of fishery schools and biological stations in Canada, for the study of fish, and other animals of the sea, of most importance to man. These are of national importance.

Mr. James Fletcher, F.L.S., and Dominion entomologist, contributed two papers in that branch of work. The first was entitled, "Report on a Collection of Coleoptera made on the Queen Charlotte Islands by Rev. J. H. Keen and J. Fletcher;" the second, "The use of Arsenites as Insecticides." Both proved highly interesting and useful.

At the closing general meeting of the society the following were elected to office: president, Dr. J. G. Bourinot; vice-president, Dr. George M. Dawson; honorary secretary, Mr. James Fletcher; honorary treasurer, Dr. A. R. C. Selwyn. In Section III. and IV., which deal more particularly with science and scientific work, the following were elected officers of sections: Section III., president, Professor E. J. Chapman; Section IV., president, Mr. Whiteaves; vice-president, Professor Macoun; secretary, Professor D. P. Penhallow.

The discussions which took place on the papers read were lively throughout, and interesting points were brought to light.

The Royal Society of Canada unanimously agreed to invite the Geological Society of America to meet in Ottawa in December.

NOTES ON STAR PHOTOGRAPHY.

BY ROMYN HITCHCOCK.

THE writer would beg the indulgence of those astronomers who may be induced by the title to read these lines in the expectation that they are the results of practical work in photographing stars. These, unfortunately, he cannot give; but inasmuch as the astronomers have so liberally availed themselves of the simplified methods of modern photography, which they can carry out more or less satisfactorily themselves, it is only fair that photographers should have a word to say now and then in behalf of the branch of investigation which they represent. By the term *photographers* I do not mean mere operators in the dark-room, nor amateurs who can make fine pictures, nor anything of the sort. I mean what may be best designated as photographic chemists, who are practically familiar with the subject from a chemical and scientific standpoint, and capable of conducting researches and designing and using apparatus for that purpose. It is certainly true that astronomers generally have neglected the surest means of achieving the highest success and advancement in their photographic work, in that they have undertaken to carry out themselves that part of it which ought to engage the attention of the highest skill and knowledge of the photographic chemist. So little is this fact recognized, that we actually sent a party to photograph the last eclipse of the sun in Japan, absolutely without either a photographer or a photographic outfit. So far from any effort to utilize the latest knowledge and methods for eclipse work, that expedition might easily have proved a total failure from the absence of the essentials for common work. When the expedition to the coast of Africa was fitted out, great attention was given to designing certain forms of apparatus; but, if I recollect aright, no photographer was chosen until a few days before its departure. Then a certain commercial brand of color-sensitive plates was chosen, but on what grounds, or whether the spectrum sensitiveness of those plates was tested at all, I have never learned. There will be an excellent opportunity for eclipse work next year; but if anything new is to be learned from it, the work of preparation should begin now in a photographic laboratory. We have apparatus enough, or we know perfectly w what is required, but we do not know the photographic process best adapted to the work.

It may be but an idle dream, but I hope to see a photographic laboratory established in connection with one of our large observatories or universities, not for routine work but for purely scientific research in photographic chemistry, such as will enable us to apply the latest knowledge to astronomical and spectrographic work.

An announcement has recently appeared, to the effect that the French astronomers have begun to doubt the value of negatives of stellar bodies taken on orthochromatic plates, because the stellar discs are surrounded by a strong aureola due to the aberration of the red rays of the objective. For this reason the permanent committee on the chart of the heavens has decided to exclude orthochromatic plates for such work.

I presume everyone finds some satisfaction in saying, "I told you so." The announcement leads me to publish now an article, on this subject, which was written in Japan between four and five years ago. It was perfectly clear to me at that time, that color-sensitive plates were being used in astronomical work when the very opposite kind of plates would have been much better for the purpose. Instead of extending the sensitiveness, it should have been restricted as much as possible. My article was not published because I deemed the facts too obvious to require discussion. But since M. Léon Vidal, editor of *Le Moniteur de la Photographie*, has taken, as I believe, an erroneous view of the matter in opposition to the practical results of the astronomers, I have looked up my old MS., and publish it herewith without change.

I would add that the opinion then expressed as regards the future of collodion plates, for all scientific work, has been greatly strengthened by the results of later investigations.

The article referred to is as follows: —

The so-called isochromatic, or orthochromatic, sensitive plates have been recommended for use in astronomical photography, in order to obtain impressions of red or yellow stars along with those having more blue and violet light in their radiations. Spectroscopic observations have shown that the light of different stars differs very much in the proportion of highly refrangible rays, and this difference must be of great influence in determining their photographic action. The ordinary sensitive gelatine plates possess a maximum of sensitiveness near the Fraunhofer line H, but some

action can be traced into the yellow as the result of very long exposure, or even still further. For ordinary exposures, however, we may consider that the action does not pass the blue, particularly when photographing bright sources of light, such as the stars, because the more refrangible rays are so very much more powerful in their effect upon the plate that they exert their full action before the others can make a visible impression. To extend the time beyond that point would result in a reversal of the effect sought for, a change in the character of the negative, and serious irradiation or spreading of the light around the image, resulting in impaired definition. With ordinary sensitive plates, therefore, the images we photograph are images made with blue, violet, and ultra-violet rays, covering, indeed, a considerable range in the spectrum, but excluding a large and important portion of it.

The differences in the character of star radiations are so considerable that the blue is sometimes very strong and brilliant, even exceeding that of the sun relatively to the other parts of the spectrum, as we find it in α Lyræ and in Sirius; while in other stars the temperature is so low that there is scarcely any blue, and line-absorption gives place to flutings, or even to the bright lines of incandescence from comets and nebulæ. It is obvious, therefore, that one star not only differs from another in glory as seen by the eye, but the photographic plate, which takes no account of any colors beyond its limited range of sensitiveness, tends to exaggerate the difference, and give utterly false evidence of relative brightness. For a red star may appear very bright to the eye, while its image on the plate would be very faint or perhaps scarcely discernable.

With orthochromatic plates the result will be different, provided the telescope itself is not at fault. We will assume for the moment that the telescope is so constructed that the "chemical" and visual foci exactly coincide, and that the plates are equally sensitive to all the colors of the spectrum. Then the negative will show exactly what is seen by the eye, and these are the only conditions under which such a result can be perfectly attained.

Doubtless such perfectly corrected telescopes, or perhaps I should say such as are so corrected within the limits of the optician's skill, are rarely available, and a very usual plan is to make certain corrections for ordinary telescopes to adapt them to photographic work. The effect of these corrections now deserves consideration.

The difference between the so-called "chemical" focus and the visual focus of a telescope may be little or it may be half an inch. In either case the photographed image will be decidedly out of focus if allowance for this difference be not very carefully made. The usual means of doing this is to change the position of the plate-holder, and find the place of the sharpest definition by trials. By properly arranging the ground-glass and the plate-holder, the plate will always be in focus for the actinic rays when the image appears sharp on the ground-glass.

Having accomplished this result, we have succeeded in doing precisely what we do not wish to do, viz., instead of arranging the instrument to photograph what the eye can see, by means of the extended and uniform sensitiveness of an orthochromatic plate, we have arranged it to define only with blue or violet rays, and have restricted its range to stars that are specially characterized by highly refrangible radiations, effectually cutting off the red and yellow stars, and rendering the use of orthochromatic plates not only useless but positively objectionable.

As regards the red and yellow stars, the greater portion of their light will be brought to a focus at the point of distinct vision, not on the sensitive plate; and the feeble radiations of higher refrangibility, being too weak to act strongly upon the plate, such stars will be but faintly shown in the negative. The rays not focussed on the plate will tend to blur the images, and this effect will be more pronounced and objectionable in proportion as the range of sensitiveness of the plate to the different parts of the spectrum is increased. For this reason the most perfect pictures would be produced, under the conditions described, by using plates sensitive only to the particular rays that form the image on the plate, or else by cutting off the other rays by a screen, thus working with monochromatic light.

It is possible that there may be some object in photographing stars with the different colors of the spectrum separately, in which case orthochromatic plates can be so prepared that they will select the particular light required, and such observations may be made with ordinary telescopes, correcting them for each set of rays in turn, in the manner described. But if I correctly understand the purpose of photographic star-maps, they are intended not only to represent the distribution of stars and their relative positions, but also to show their respective brightness, or, as we usually call it, magnitudes. Now magnitude measured by brightness is not the same as the photographic action of the stars upon a plate of restricted spectrum sensitiveness, such as all ordinary sensitive plates, and this, although a self-evident proposition, has not received in practice the attention it deserves. On the other hand, orthochromatic plates will give perfectly truthful representations of the starry heavens when used with perfectly corrected telescopes, as already explained, and that they will only do so under such conditions is, I believe, obvious.

If it is possible to make plates of uniform sensitiveness as regards tests in the sensitometer, and also as regards all the rays of the visible spectrum, and if such plates can be produced regularly in large quantities, we may consider the problem of photographing the stars to be satisfactorily solved. But much yet remains to be done before a plate that can be regarded as standard can be adopted. The composition of the emulsion, the manner of rendering it sensitive, the means of testing the plates, including the standard of light to be used in the process, and the keeping qualities of the plates, must all be thoroughly investigated before it will be safe to adopt a standard plate for universal use. Nevertheless, we are in a position now to begin practical work, and the results will be of permanent value if we act upon the proposition that with orthochromatic plates there is no distinction of chemical and visual rays, and that such plates can only be advantageously employed when all the rays from red to ultra-violet are brought to a focus in a single plane.

I do not venture upon any speculations as to the probably best method of preparing color sensitive plates for astronomical work, for the reason that new methods are constantly being tried. I will say, however, that I deem it not at all improbable that collodion will be found superior to gelatine as a vehicle for the emulsion, and although the gelatine plates are at present more rapid than collodion emulsion plates, there is no obvious reason for this, further than that we not yet know how to make extremely rapid plates with collodion. But there are some objections to gelatine and none to collodion. Gelatine swells in water, particularly in warm climates, and, although this defect can be to some extent controlled, it is really at times a serious trouble, which no "tropical"

plates can entirely overcome without a sacrifice of other good qualities.

The great point in favor of collodion is that it seems to lend itself peculiarly well to the production of color-sensitive plates, and this, coupled with the uniformity of the material that can by proper means be secured and the clearness with which it works, leads me to anticipate that it will eventually rival gelatine for fine, delicate work, and I believe it will come to be highly favored in astronomical work and spectrographic work.

Washington, D.C., June 10.

GLACIAL PHENOMENA IN NORTH-EASTERN NEW YORK.

BY D. S. KELLOGG.

CLINTON COUNTY, the very north-eastern county of New York, offers an interesting field for studying glacial phenomena. The rock striæ generally are nearly north and south, though in one place at least they are almost east and west. In many places the outcropping ledges are oval mounds with their longest diameters in the general direction of the supposed motion of the glacier.

There is an abundance of marine shells everywhere in the lower lands. These may be near the present surface and turned over by the plow in such quantities as to make the fields white, or they may be found from 5 to 10 feet under ground. A stratum 2 inches thick underlies much of Plattsburgh village at a depth of 5 or more feet. These are *Saxicava arctica* and *Macoma greenlandica*. Others undoubtedly are present in this county. The highest I have yet found are 346 feet above tide-water.

In Beekmantown ends a tortuous kame, over 50 feet high, which has been traced and mapped north into Chazy, 6 miles. Much of this is laid down upon clay of the former lake-bottom.

The lower slopes of Rand Hill and of Dannemora Mountain are covered with deposits of till, which wells of 50 feet do not go through. I have been over much of this surface for a distance of 20 miles north and south and of 6 miles east and west. There are scores of kame-like ridges from 5 to 70 feet high, generally running north and south, but sometimes in all directions. These ridges form a large number of swamps, varying in size from half a square mile down to a few rods. The bowlders and cobble-stones in these deposits are largely of sandstone, which crops out in immense surfaces in the northern part of the county, and probably lies underneath much of this till. At Cadyville in the Saranac valley, 10 miles from Lake Champlain, the glacier moved across the old valley, making by its deposits a dam 2 miles wide and upwards of 100 feet high. This dam made a lake 8 or 10 miles long, 2 miles wide, and in places 100 feet deep. This lake has been entirely emptied out. The Saranac River has not only cut a channel through this till dam, but has also made a gorge 60 or more feet deep in the sandstone that underlay the lower half-mile of the dam. Probably the old buried channel is not far distant. What was once the bottom of a portion of this lake is now known as the "seven-mile run" in the Saranac River.

The Lake Champlain of the closing glacial period reached up to the lower border of this glacial dam, 500 feet higher than the present lake and 600 feet above the sea. When at its highest level a plateau was formed that extended 2 miles or more out in the lake. After a time the lowering of the lake by the erosion of its outlet left this plateau uncovered. Then a second was formed, perhaps 250 feet lower than the first, spreading out several miles. A third lowering formed a third plateau, on which much of Plattsburgh village now stands, and which makes "The Plains," south. This third plateau in general is from 50 to 75 feet above the present lake, and, like the other two, is composed mostly of sand. Nearly all the time while these plateaus were forming, the outlet of Champlain was south into the Hudson.

A dam of 60 feet now in the Richelieu would throw the Champlain water into the Hudson, unless there is a lower valley out from the Missisquoi Bay. By erosion of the valley from Whitehall to Fort Edward the lake was lowered until the ice had retreated enough to allow the Richelieu to be made. I have not studied the conditions between South Bay and the Hudson. For a time this may have been one of the southern outlets of Champlain. The Champlain Canal at Fort Edward receives its water from a feeder which taps the Hudson at Glen's Falls. *This* water from the Hudson flows north now from Fort Edward in the canal, and empties into Lake Champlain.

Did the pre-glacial upper Hudson flow through into the old river bed which is now Lake Champlain and thence into the St. Lawrence valley?

Plattsburgh, New York, June 13.

NOTES AND NEWS.

IN a circular, "American Reports upon Anatomical Nomenclature," issued last winter by Professor Wilder, as Secretary of the Committee of the Association of American Anatomists, in the third paragraph of the third page, the Chairman of the Committee of the Anatomische Gesellschaft should be Professor A. von Kölliker, and the chairman of the American division (appointed in 1891 by the American Association for the Advancement of Science) of the International Committee on Biological Nomenclature should be Professor G. L. Goodale. Professor Wilder desires to express his regret for the errors, due in the one case to his own misapprehension and in the other to a clerical mistake.

—Professor Bardeleben has recently delivered an address in Berlin on the modern bullet (*British Medical Journal*, May 21). The modern rifle sends a bullet with a narrow cylindrical form and pointed apex, which at a distance of 1,000 metres has the power to pass through several human bodies or to disable two horses. Its line of flight differs but slightly from the line of sight. It has an inner core of lead enclosed in a casing of steel which prevents the lead from becoming deformed and spreading at the point of contact. This change is of much interest for military surgery. The bullet is lighter than any of the lead bullets, but is sent with a greater velocity. On account of its velocity and its small surface of contact, it merely punches out a hole causing very little commotion of the neighboring parts. It is more likely to cause fatal hæmorrhage than the old bullet. If the new bullet wounds at all it will have sufficient power to pass through any part of the body. Colonel Boonen-Rivera, in his report on the civil war in Chili, the only war in which Mannlicher rifles have been used, says that the number of dead on the battlefield was four times larger than that of the wounded. The effect of these bullets on bone has been made the subject of a series of experiments. Up to a distance of 400 metres the bone is invariably shattered, and at greater distances either clean perforations or oblique fractures result. In the next war the ratio of recoveries of those who can be removed still living from the field will be larger than formerly. The new projectile is by no means so humane as it is sometimes called, since within similar periods of time and under equal conditions it kills and wounds more men than the old bullet. But the wounds which it causes, if they are not of a directly fatal nature, open to the surgeon, as a general rule, a far more promising field for exercising his skill and activity than those which were caused by the old bullet.