past there has been discernible a considerable degree of separateness, with only a minority of the leaders effective in both respects. During this period of intense cultivation of pure mathematics for its own sake a number of mathematical systems grew to high stature in advance of any but elementary contact with experimental science. Among these is the Riemann geometry and its associated general calculus, unwisely named "absolute," which was elaborated some time before Einstein found his remarkable physical interpretation for the four-dimensional case, although Riemann and Clifford foresaw something of the possible physical meaning of curvature. Thus, in contrast with the Newtonian system, the Einstein mechanics found its natural mathematical machinery already highly perfected. In a more general philosophical sense it may be remarked that the postulational movement in abstract mathematics represents a kind of relativity movement, with its reaction on the concrete sciences just beginning. There will be other examples like the Riemann-Einstein of anticipation and fruition, and in particular if time permitted it could be pointed out how some of the existing fields of mathematics seem peculiarly adapted to the special needs of chemistry, though their possible value in this way is only meagerly appreciated.

This same epoch of independent mathematics has witnessed a great increase in the variety of physicochemical phenomena experimentally studied and the variety of measurements and technical devices used in their exploration. But chemistry is still only approaching the stage of mathematical formulation, and in both sciences there has been a marked growth in the relative prominence not only of what have been called secondary theories but of shadowy notions, mystical hypotheses and vague analogies. The art of the experimenter has outrun the vision of the logical physical theorist, while pure mathematics, not keeping such fullness of contact with its concrete origins, has been discovering more consciously its own natural character and powers. But the new wealth of experimental knowledge may become a bewildering burden if its theoretical counterpart remains too much a maze of special and even partly contradictory hypotheses. It is needful that a wider range of experimental results be brought under control by simple and comprehensive primary theory, and there is now a wealth of mathematical material at hand for the purpose. The world geometry has made one great stride in this direction and opened other paths just beginning to be followed. It is clearly desirable that the promise and power of its way of thinking should not be masked by undue emphasis on its relation to special experiments.

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MYSTERIOUS ACOUSTIC PHENOMENA IN YELLOWSTONE NATIONAL PARK

IT is highly gratifying that the American people are making yearly increasing use of the Yellowstone National Park and that each season many thousands become for the first time acquainted with its beauties and wonders. Among future visitors there will be some who will experience the strange and bewildering musical sounds that for many years have been noted in certain parts of the park. As a partial contribution to the solution of the mystery, a personal observation on one manifestation of the weird phenomena may be of interest.

This subject has received scant mention in various published reports and articles, and by some people has been relegated to the category of yarns and myths which helped to make Jim Bridger famous. The best account seems to be that contained in the best work[1] on the park, that of General Chittenden, from which the following quotation is taken (pages 288–289):

> A most singular and interesting acoustic phenomenon of this region, although rarely noticed by tourists, is the occurrence of strange and indefinable overhead sounds. They have long been noted by explorers, but only in the vicinity of Shoshone and Yellowstone Lakes. They seem to occur in the morning and to last only for a moment. They have an apparent motion through the air, the general direction noted by writers being from north to south. They resemble the ringing of telegraph wires or the humming of a swarm of bees, beginning softly in the distance, growing rapidly plainer until directly overhead, and then fading as rapidly in the opposite direction. Although this phenomenon has been made the subject of scientific study, no rational explanation of it has ever been advanced. Its weird character is in keeping with its strange surroundings. In other lands and times it would have been an object of superstitious reverence or dread and would have found a permanent place in the traditions of the people.

In the summer of 1919, during a visit to the park in connection with governmental fish-cultural and fish-planting work therein, the present writer, in company with Mr. A. H. Dinsmore, of St. Johnsbury, Vermont (a former superintendent of fish hatcheries in the park), made a camping trip to Lewis and Shoshone Lakes, employing pack horses, with helper, and having as a part of the equipment an Oldtown canoe transported by motor truck from Yellowstone Lake to Lewis Lake.

About eight o'clock on the morning of July 30, after having camped for two days and two nights on the shore of Shoshone Lake at its outlet at the

[1] "The Yellowstone National Park," by Hiram Martin Chittenden. New and enlarged edition. Cincinnati, 1915.

southern end, we entered the canoe and pushed off from the shingly beach, headed for the northern end of the lake. The surface of the lake was glassy, the air was still, a faint haze overhung the water, the sky was cloudless, and the lake for a considerable distance out was in the shadow of heavily timbered hills. The canoe had barely gotten under way and was not more than twenty meters from the shore when there suddenly arose a musical sound of rare sweetness, rich timbre, and full volume, whose effect was increased by the noiseless surroundings. The sound appeared to come from directly overhead, and both of us at the same moment instinctively glanced upward; each afterward asserted that so great was his astonishment that he was almost prepared to see a pipe organ suspended in midair. The sound, by the most perfect gradation, increased in volume and pitch, reaching its climax a few seconds after the paddling of the canoe was involuntarily suspended; and then, rapidly growing fainter and diminishing in pitch, it seemed to pass away toward the south. The sound lasted ten to fifteen seconds and was subsequently adjudged to range in pitch approximately from a little below center C to a little above tenor C of the pianoforte, the tones blending in the most perfect chromatic scale.

It was at once realized that this was probably a manifestation of the strange phenomena referred to by General Chittenden, whose book had been read in camp, and that an opportunity was presented to investigate and perhaps elucidate the mystery. So favorable was the opportunity that in a short time we were reproducing the sound at will.

Following the dying away of the music and the short period in which we were held spellbound, paddling was resumed and, as the canoe gained sufficient headway, the music recurred in practically the same form as at first, and, as the paddling ceased and the momentum of the canoe fell off, the sound died away. It was then perceived that the sound was coincident with the motion of the canoe: when a certain speed was reached and maintained, the sound was produced and maintained; before that speed was attained there was no sound, and after that speed was lost the sound ceased.

A search for the cause of the sound disclosed the following situation: A jointed bamboo salmon rod with its butt-end touching the side of the canoe was projecting backward about half a meter beyond the gunwale; the waxed silk line was reeled in, but about a meter of line with the lure at the end was wrapped several times around the terminal joint; a lead sinker weighing one hundred grams, that had been attached in order to carry the lure into deep water frequented by the large trout with which the lake had been stocked, was dangling from the end of the rod about five centimeters below the surface of the water. As the canoe moved through the water, the short length of free line, held taut by the sinker, rapidly vibrated in conformity with the speed of the boat; the vibrations were transmitted through the bamboo rod to the canoe, whose thin, curved, rigid sides and bottom acted as a sounding board and gave out an augmented volume of sound that seemed to be concentrated or focused overhead. The combination of essential factors present in this case seems to have been a smooth water surface, a vibrating cord, a resonant body to which the vibrations were transferred, and still air, with perhaps other favorable atmospheric conditions. Later, in other parts of the lake, where the surface was disturbed by ripples or waves and there was slight to moderate movement of the air, attempts to reproduce the sound were futile, although the other factors were as in the original manifestation.

It is not to be inferred that the conditions and explanation herein given are held to account for all the mysterious musical sounds that have been heard in the park. On the contrary, owing to the rarity of the occasions when canoes had been used in park waters, it seems likely that the exact combination of factors noted must have been exceptional. All that is claimed for this manifestation is that it fulfilled the requirements of the mystery as described by the best observers and that its cause was ascertained. An account of the occurrence was promptly given to the superintendent of the park.

That acoustic conditions on Shoshone Lake that morning may have been peculiar is suggested by another observation as the canoe was skirting the eastern shore of the lake and the Shoshone Geyser Basin came within visual range. During several of the eruptions of the principal geyser, the splashing of the geyser water on the hard siliceous platform was distinctly heard. The distance in an air line, according to the official Geological Survey map, was approximately nine kilometers.

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SIR JOHN BURCHMORE HARRISON

WITH the recent announcement in SCIENCE of the death on February 8 of Sir John B. Harrison, director of the department of science and agriculture in British Guiana, it is fitting that some reference should be made to the career of this distinguished chemist, whose work is unfortunately too little known to American scientists.

John Burchmore Harrison was born at Birmingham, England, on May 29, 1856, and received his preliminary education at the Edgbarton Proprietary School, after which he became a student in Christ's College,