men (for they have nerves, perhaps as keenly sensitive as their employers), than the harsh voice of a foreman, or superintendent, constantly heard in angry scolding and nagging at the men above even the noise of the machinery.

Let the employer, therefore, always study the welfare and interests of his men, let him not look down upon them as if they only formed a part of the machinery of his establishment, but feel for them a real interest, encouraging the young mechanic to habits of industry and sobriety, by kind words and by his own example. When he finds a workman superior to another in ability, if that man considers he is entitled to some increase in his wages over that of another, far inferior to him in skill, let him have it. Never abuse your men with harsh words, and never approach them with familiarity, for once a foreman forgets his proper position inside the factory, he has lost his influence, respect, and power over those he employs. On the other hand the employed should cherish a desire to do their work cheerfully and honestly, and if they feel they have a grievance, represent it in a dignified and respectful way, which will go far to have it investigated and remedied; for there are, after all, few employers so blind to their own interests as to part with really deserving and skilful workmen without just cause, or who would not remedy a grievance if brought respectfully before them.

As this article closes the editor's connection with the SCIENTIFIC CANADIAN, he trusts that the efforts he has made during the past four years to improve it, as far as it was personally in his power, and his responses to the numerous calls for scientific and technical information (which were given gratuitously), has been appreciated by the subscribers. There is, however, still a wide scope for improvement, which he sincerely hopes will be realized by its future supporters. He tenders them his best wishes for prosperous times, a Merry Christmas and a Happy New Year.

PRACTICAL VALUE OF SCIENCE.

Our obligations to the branch of physics are almost unlimited, but we will mention only two or three applications of a single agent in this wide field. It would seem to roll back the world into the dark ages to take from it now the benefits of electricity in its multiplied and yet rapidly multiplying applications.

It seems incredible, from our present standpoint, that so short a time ago, in our congressional halls, the electric telegraph was almost ridiculed and voted into oblivion, from which it could never rise. When a bill was presented, appropriating $30,000 to be expended, under the direction of the Postmaster-General, in a series of experiments to test the merits of Morse's electric-magnetic telegraph, one member moved an amendment requiring half the appropriation to be used for the encouragement of mesmerism. Another proposed to include Millerism in the benefits of the appropriation; others to appropriate part of the sum to a telegraph to the moon. And when the bill came to a final vote, this was so close that a change of three votes would doubtless have left us till this day without the benefits of the telegraph. After his invention was in working order, and transmitting messages between Baltimore and Washington, Mr. Morse offered it to Congress, to be attached to the Post-Office Department, for the sum of $100,000. But it was declined, on the statement of the Postmoster-General, who reported that, while the invention was "an agent vastly superior to any other ever devised by the genius of man," he was not satisfied that "under any rate of postage that could be adopted its revenue could be made to equal its expenditures." By this short-sighted want of appreciation of science, the United States Government deprived itself of a source of revenue sufficient, doubtless, to liquidate the entire national debt in a single decade.

The application of electricity, now attracting world-wide attention, enjoys a vastly more hearty reception than did the telegraph. The *telephone* is constructed on the principle of the human ear. It consists of an elastic diaphragm to receive vibrations of air from the human voice or from other sources, so connected with the wires of a battery (or even with wires without a battery) as to communicate the same vibrations in every respect to another membrane or diaphragm situated at a distance. The two diaphragms of a telephone in distant places correspond, in every practical sense, to the two membranes of the human ear, and the connecting wire to the chain of bones between the two membranes. Probably no invention has come more rapidly into popular favour. Already many thousands of them are in practical use in this country and abroad.

The speaking phonograph is also copied from the human ear. The vibrating diaphragm, in this case, has a stylus connected with it, which impresses the peculiarities of vibration, due to any particular sound, upon a roll of tin foil arranged to receive the impression. By reversing the process, the indentations and prominences of the tin foil cause the stylus to fall and rise, which results in vibrations of the membrane, and these reproduce the original sound. These impressed sheets of tin foil may be preserved or mailed to any part of the world, and by putting them into a similar instrument, may be made to reproduce the pitch, tone and quality of the original sound thousands of miles or of years distant. By this instrument, voice may be phonographed, as the face is photographed, and we may listen to the veritable voice of the dead, or preserve for future comparison the voice of a person from the first infant prattle and the manly utterances of mature life even to the feeble speech of old age. Public speeches and songs may thus be preserved and delivered indefinitely or till the tin foil wears out. In public libraries may be preserved languages of different nationalities spoken from century to century "with all the peculiarities of pronunciation, dialect and brogue."—*Prof. Towbridge in the Advance.*

HARDENED STEEL.—The well-known fact that steel is of less specific gravity after hardening has given rise to varied explanations as to the cause, but it seems no unnatural result when viewed in connection with the general experience with other metals under heat treatment. It is indeed a matter of some surprise that so much doubt and difference of opinion should exist. In tempering or hardening, the steel is heated to the required temperature, and then dipped into the hardening fluid, and thus undergoes a rapid cooling process. The effect of the rapid cooling is to hastily set the outer surface of the steel with a slight contraction around the hotter and still expanded metal within, leaving the volume of the steel a trifle greater than if all the molecules had been cooled simultaneously, and allowed their own share in contraction, which would have the effect of a gradual cooling of the steel, when the metal would have returned to its original constitution prior to heating. It is for the same reason that a steel bar, being heated and one face only dipped into the cooling or hardening fluid, will be longer on the tempered or cooled face than on the untempered face, demonstrated in the bending the bar, the hardened portion being the outer or longer surface of the bend. The tempered face is cooled suddenly, and "set" while the bar is still of nearly a length due to the expansion of heat, and the rest of the bar cooling gradually has a tendency to shrink or contract normally, but is affected by the set condition of the tempered portion. The bar, if of wrought iron, would not show as great a bend as if of steel, owing to the fact of wrought iron being a somewhat better conductor of heat, and to the greater freedom of action in the molecules of wrought iron than those of steel. The result of a similar treatment of copper (gold or silver) would be much less marked than in either steel or wrought iron, with correspondingly less variation in specific gravity, the heat conducting powers and freedom of molecular action of the former metals being much greater than of iron and steel. Glass or porcelain being very poor conductors of heat, and the molecules having little freedom of action, snap asunder under the same treatment. To recapitulate: The specific gravity, under the circumstances mentioned above, would vary inversely as the power of heat conduction and freedom of molecular action of the various metals and substances experimented upon.—*American Engineer.*

TO CLEAN MARBLE.—An equal quantity of fresh spirits of vitriol and lemon-juice will remove stains from statuary marble. Put in a bottle and shake up well, wet the spots with the mixture, and in a few minutes rub with a soft linen cloth till they disappear.