or rather tension, acting on the "playing pneumatics" or small bellows which operate the fingers, and the duration of the impulse necessary to produce the maximum effect is greater for the bass than the treble hammers. Now the regulating bellows are in a continual state of vibration, producing rapid fluctuations of tension every time a note is played. If these fluctuations synchronise with the impulses required to produce the maximum effect in a particular part of the scale, it is evident that the corresponding part of the chord will predominate. Now, in playing softly the regulating bellows are only slightly compressed, and they open and shut slowly; in playing loudly they are much more highly compressed, and they collapse and open sharply. Thus the unpleasing want of balance in the quality of chords is easily accounted for. This difficulty I get over by varying the load on the regulating bellows, and also the inertia by means of a sliding weight, as well as by controlling its vibrations by hand. I have seen a patent in which it is sought to control the regulating bellows by enclosing it in an air chamber in which the tension can be varied by means of valves, and attempts have also been made to vary the tension in a spring controlling the bellows; but this can only be done by compressing the spring by a corresponding amount, and the time required to produce this compression appears to be too long to render the method efficacious.

The usual method of concealing this want of balance is to operate the two halves of the keyboard with separate controls. This system produces effects which are pleasing at first, but are very artificial and limited in character, and a person who is accustomed to this method of "faking" his chords is scarcely likely ever to learn how to balance their different parts with due regard to the effects required. Possibly this explanation may clear up some of the obscure points in my descriptions referred to by Prof. Morton. At the same time, I have heard professional pianists of considerable reputation whose range of control did not extend beyond that obtainable by damping down the halves of the keyboard or accenting notes by means of punch-holes.

Prof. Pickering's references to the sustaining pedal or lever are calculated to suggest the inference that Prof. Pickering may not have had much experience in manipulating his piano-player. If he finds it necessary to listen for each note before he knows when to operate his sustaining lever it would appear that he has not yet learnt *to play each note at the exact instant that he wishes it played,* and in this case it is not easy to see how it would be possible to play accompaniments in which it is necessary to listen to and keep in time with the soloist. Personally, I have always considered that the sustaining lever played a far more important part in pneumatic playing than in hand playing, one reason being that the necessary movements can be regulated with much greater rapidity and precision by hand than by foot. The right hand operating the speed regulator fixes the exact instant at which each note is going to be played, the left hand operates the sustaining levers and other controls at the correct predetermined instant. Probably, as Prof. Pickering says, an experienced pianist can also work hand and foot together, and I have known one musician who could operate the sustaining pedal of the piano three times in succession in holding down a single chord. This would be quite easy with a piano-player, and I certainly often use the lever twice if not three times in playing a chord. But it must be much more difficult to do the same in playing with fingers, and with the majority of amateurs the main use of the loud pedal appears to be to compensate for the loss of resonance caused by boxing up the piano and covering it with rugs, vases, and photograph frames.

The slight sound of suction through the air-holes is, of course, an inevitable defect, but one soon ceases to notice it. As regards "thud," well, fingers as well as pneumatics sometimes produce this.

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The Light Energy Required to Produce the Photographic Latent Image.

THE amount of light energy required to produce a latent image on a modern high-speed photographic plate is known to be extremely small. The energy per silver grain may be roughly calculated without difficulty, and the calculation leads to some interesting conclusions regarding the nature of the latent image.

Consider an exposure sufficient to produce a deposit of unit density, that is, one which will transmit but one-tenth of the incident light. A negative has unit density when the silver deposit is 10 milligrams per square decimetre, or 0·1 mg. per sq. cm. (Sheppard and Mees, "Investigations of the Theory of the Photographic Process," p. 41). This amount of silver represents roughly 10^{12} molecules, or 10^{7} grains 3 μ in diameter. Now the amount of light energy required to produce an exposure giving unit density is of the order of 10^{7} watt-sec (erg) per sq. cm., and therefore 10^{-14} erg per grain, or 10^{-26} erg per molecule. The probable uncertainty in these values is not greater than a factor of 10.

The effect of the light on the plate is to permit the chemical reduction of silver halide to *metallic* silver with an additional expenditure of energy less than that required to reduce the unexposed silver bromide. Development we know to proceed by whole-grain units, hence we reason that one molecule in a grain (10^{12} molecules) is so affected by exposure that the whole grain is developable.

The simplest assumption to be made is that one electron per grain is detached from one molecule; such a liberation would require (Davis, *Phys. Rev.*, xx., p. 145, and others) 5×10^{-12} erg, or less (*Astroph. Journ.*, xxi., p. 404), a quantity consistent with that calculated above from the known exposure and mass of silver. Hence the hypothesis is reasonable that the latent image consists of halide salt in each grain of which one electron has been liberated by exposure to light.

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An Aural Illusion.

MR. ALLISTON refers in NATURE of September 18 (p. 61) to a certain aural illusion, and wonders if anyone has thought of it before.

Two or three years ago, in a letter to *Knowledge,* I commented on the fact that if a flash of lightning 2 or 3 miles long happened to occur "head on" to an observer, the result of the flash travelling so far quicker than the sound would be that he would hear first the thunder caused by the part of the flash nearest to him, which arose last, and then in succession the earlier sounds until finally he would hear the opening crash, like a phonographic record reversed. Sometimes I have noticed that a thunder peal ends up with a sudden and more violent crash, and I wonder if this is owing to the explosion which begins a peal of thunder being louder and more abrupt than the after noise

T. B. BLATHWAYT.

Cape Town, October 10.