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Table listing various articles such as Agricultural appliances, Birds that eat acorns, Dynamo armature, and others with corresponding page numbers.

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

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Table listing sections I through IX, including Entomology, Geography and Exploration, Mechanical Engineering, Medicine and Hygiene, and Technology, with page numbers.

A RECENT PROJECTILE TRIAL.

A very interesting ballistic trial of an armor-piercing projectile took place on November 10, at Reddington, Pa.

While great strides have been made in the development and manufacture of armor and guns in this country of late, the subject of armor-piercing projectiles has not been neglected.

In this country a number of steel makers have taken up the study, manufacture, and development of projectiles, some having purchased the secret processes of foreign makers.

The projectile fired at Reddington was one that had been manufactured under the Wheeler process, by the Sterling Steel Works, at Demmler, Pa.

It was then sent to Reddington, to Lieut. J. F. Meigs, United States navy, who fired it again on November 10. He gave it a velocity of 1,660 feet per second, firing at a soft nickel-steel plate of 14 inches thickness.

The point and ogival head were in splendid condition and were highly polished. The cylindrical part of the projectile had split longitudinally, one part remaining intact with the ogival head, the other part detached.

The average projectile either breaks up or becomes so distorted on the first fire at a modern armor plate that it is useless; but this one had passed, with very slight distortion, completely through one plate, and on its second firing did not break up badly.

THE COMET.

A day or two after the date of this issue of the SCIENTIFIC AMERICAN the earth will be on intimate terms with a celestial visitor from far-off regions. For on November 26 and 27 it is calculated that Biela's comet will be probably within one million miles of the earth.

For to-day we know little of comets. They have as distinctive features a head or nucleus and a tail. The latter is of such excessive tenuity that although it may be conspicuous on the absolutely black background of the heavens, yet stars can shine with virtually undiminished luster through a million miles of it.

Sir Isaac Newton compared the brightness of a comet's tail to that of the notes in a sunbeam an inch or two thick. Imagine this diffused through the vast space filled by the comet.

But the nucleus of the visitant is more solid and contains a greater concentration of mass. From it the tail emanates. The tail points away from the sun in whatever direction the comet is moving, suggesting Stockton's "negative gravity."

speck may be solid incandescent matter or may shine by reflected light. From it in its passage through space fragments of all sizes may be torn off and distributed along the comet's orbit.

The tail of a comet points away from the sun. Running down its axis, a dark straight line has been observed. This seems to be the shadow of the unknown nucleus.

Volcanic eruptions making or annihilating islands impress us as overwhelming in their might. The impact of a cometary nucleus in the formation of a crater, with the possible penetration of the earth's crust, and in the creation of tidal waves, might affect the destinies of a continent.

But even this is all conjecture. Meteorites are principally composed of metallic iron and nickel. These incidentally are about the last things we should look for in them.

An extraordinary thing is noted by Langley. Sir Isaac Newton, he says, made one of his "guesses" in this connection that take the nature almost of prophecy. Two hundred years before the spectroscope was invented, and a century before the work of Black had borne its fruits, Newton surmised that comets might supply the atmosphere with its carbonic acid gas.

The comet of 1680 was subjected to heat two thousand times greater than that of red hot iron, according to Newton's calculations. From the neighborhood of the sun the comet flew into the regions of almost absolute zero.

The size of meteorites is generally small. In view of their high velocity this is a fortunate circumstance for us, who have to stand their bombardment. They are also very widely dispersed. In a shower of meteorites, it is probable that the individual masses are ten miles apart.

When the earth meets these asteroids, which are of far more than icy coldness, they fly through its atmosphere with enormous velocity. As certainly as the impact with an armor plate heats an iron cannon ball, so the friction with the atmosphere heats the celestial projectile.

Here is at least a notch or foothold for a theory. The meteorites which reach us intact are masses of nickel and iron. Curiously enough, one of the very alloys proposed for use in making projectiles for guns and armor for war ships is a nickel-steel alloy, so that we are not yet much in advance of the celestial artillery.

Leaving this aside, we may assume that, however large the nucleus of a comet is, it is composed for the most part of carbon and of easily disintegrated materials to which our atmosphere will offer a real resistance.

This would account for the cosmic dust, and for the survival of the fittest projectile material, nickel-iron or nickel-steel, for even the carbon is there for its cementation. This gives us the satisfaction at least of feeling that our earth's envelope of oxygen and nitrogen will protect us from all but metallic projectiles, and if we are to be bombarded, it will be with improved and modern shot.

THE demand for Percheron horses for export is so great that the purity of the breed is threatened, and a stud-book has been started in France by which the pedigree may be preserved and the race kept up to the standard

The Typewriter in Cipher Writing.

A curious suggestion in regard to certain possible uses of the typewriter is made by M. Erve, in *Le Genie Civil*. It is well known that a favorite form of cipher writing consists in substituting certain letters for others, each party to the correspondence having the key by which he can place the substituted ones by those intended to be read. M. Erve points out that a secret correspondence of this sort can be carried on very readily by means of any typewriter. All that is necessary is to transpose types on the type-bars, so that, for example, touching the key marked A will print C, B will print R, and so on. After one instrument has been so transposed, the other is to be correspondingly rearranged, so that the key C will print A, the key R will print B, and so on. Then X., the correspondent at one end of the line, on receiving a cipher dispatch from the other, Y., has only to copy it on his typewriter. The machine, retransposing the letters automatically, will at once give an accurate translation, while X.'s reply, written on the same typewriter which translated Y.'s original dispatch, will form an unintelligible string of letters, which, by copying on Y.'s typewriter, will be in its turn translated. A cipher correspondence of this kind has an advantage over the ordinary sort, in that the two parties use different, although reciprocal, ciphers, and a comparison of dispatches captured from each will give little clew to the meaning of either. Moreover, it would not be very difficult, with some typewriters, which have two space keys, to make the space keys actuate types, so that the document would be an uninterrupted string of letters. Such writing is very difficult to decipher, from the impossibility of telling where the words begin or end; yet the corresponding instrument, by mere copying, would translate it perfectly.

Another use of the typewriter which M. Erve suggests is an instrument for shorthand writing. Most stenographers, in addition to the characters for sound, employ a large number of abbreviations and signs, usually of their own devising, which no one but themselves can understand. Hence it comes that stenographers cannot read any one else's writing but their own, and occasionally fail to read that when their use of abbreviations has been too liberal. M. Erve says, very truly, that characters indicating sounds with sufficient accuracy can readily be found in the typewriter alphabet, while a code of abbreviations might easily be agreed upon among stenographers. With such a phonetic system of using the characters, and a reasonable number of abbreviations, it would be easy to write four hundred words a minute on a typewriter, which would be fast enough for the most rapid speaker, while the stenographic writing would have the great advantage of being legible to any other stenographer besides the one who wrote it.—*American Architect*.

Has Albumen Received its Death Blow?

It will be remembered that recently, and as an append to a letter from the Britannia Works Co., relative to the uniformity of the tones obtainable on the Ilford Printing-out Paper (the "P. O. P." as it is usually termed), we spoke in terms indorsing their statement of this quality. This we did after a careful examination of from four to five dozen cabinet portraits which bore the name of W. H. Midwinter & Co., Bristol.

There was something so exquisitely beautiful and delicate and vigorous withal about these pictures that we felt impelled to address a request to Mr. Midwinter for detailed information concerning his *modus operandi* for publication either in the *Journal* or *Almanac* or both, as we saw occasion. To this a courteous response was made, with an offer, should we find it convenient to visit his establishment, to afford us every facility for witnessing the whole of his operations from beginning to end—an offer of which we promptly availed ourselves.

From the high position Mr. Midwinter occupies in the profession and his long experience in photography we consider him, more than many others, entitled to speak with authority—a feeling that has been strengthened since we spent a forenoon in his admirably fitted up ateliers in 48 Park Street, Bristol.

Conversing on the subject generally of our visit, we were informed that for a considerable time albumen had been entirely banished from his place, his printing now being confined to gelatine "P. O. P." and platinum. Information of this nature coming from such a representative man augured ill, we thought, for the long-continued tenure of the sway that albumen has had without any rival worthy of the name for these forty years past. Good old albumen! It has served us well during its reign; and, in the prospect of its being sooner or later deposed, we must endeavor to overlook demerits inseparable from its nature, and cherish its memory as that of an old friend who has rendered us good service. It is perhaps premature to cry, "The king is dead! Long live the king!" but, remembering our forecast many years ago concerning the chances of collodion retreating in favor of gelatine as a factor in making negatives, we imagine that, in course of time,

and that too at a not distant period, albumen as an agent in printing will have to retire from the prominent position it has so long occupied.

Like so many other establishments, the printing room of Mr. Midwinter is covered in with glass, and it has the usual facilities for changing and filling the printing frames. It was, however, the subsequent treatment of the prints in which we were now more peculiarly interested.

Examining a few dozen prints as taken from the frames, we found that, contrary to the custom of some who use gelatino-chloride paper, these were slightly over-printed, not very much so, but to rather a less extent than adopted by experienced albumen printers. In the toning room, which is large and roomy, the utmost cleanliness and method prevail. Along one wall, that in which the windows are, there are arranged six slate tanks side by side. Above each there are water taps, and in the bottom are two outlets, one to permit of relegating valuable waste to its suitable receptacle, the other communicating with the sewers. We observed that no sooner had a tank been done with than it was thoroughly washed, sides and bottom, with a large sponge; and we further observed that separate sets of sponges and brushes are employed for the various tanks; thus, the brush for the hypo tank could not possibly be used in any but its own, unless one were willfully to ignore the lettering on its back. This cleanliness and method are perhaps due to the fact of Mr. Midwinter having in early life graduated in a chemist's establishment, where, above all places, cleanliness and method must reign supreme.

The first operation was to immerse the prints one by one in a water bath, from which, after a good soaking, they were transferred to the alum bath. This consists of—

Alum.....	4 ounces.
Water.....	80 ounces.

The chief printer—a most intelligent man—told us that he had at first adhered to the directions issued with the paper, which recommended eight ounces of alum to this quantity of water, but that he had reduced the strength to four ounces without any discoverable disadvantage. After remaining in the alum solution for ten minutes, the prints were then subjected to a wash in a succession of three changes of water. This washing was not done in a perfunctory, but in a thorough manner. At this stage the prints had lost the purple tone they had when taken from the printing frame, and had acquired a red color similar to that which albumen prints have at the stage after being immersed in a solution of chloride of sodium or acetic acid previous to being toned—a custom adopted by some.

The toning bath consists of—

Sulphocyanide of ammonium.....	30 grains.
Water.....	16 ounces.
Chloride of gold.....	2 grains.

Of this a quantity sufficient is poured into the toning dish to give the prints plenty of room in which to float about without danger of one sticking to the other. Mr. Midwinter strongly urged this as an important point both in convenience of working and as insuring uniformity of tone. We noticed that in measuring out the toning solution two-thirds of the bath used the day previous were taken and refreshed with one-third of a new bath. This we think is an excellent system, viewed either economically or from the point of convenience, for in our estimation some of the toning baths employed with gelatino-chloride paper act too energetically to enable the requisite care to be taken in seeing that, when a considerable number of prints are being manipulated by one person, due care is taken in insuring uniformity. How otherwise could it be when contrasted with the helter-skelter turning over of prints, accompanied by a fear to devote more than a very few seconds to the examination of any one print in case the others are in the meantime getting spoilt by over-toning? No occasion for such hurry when the toning solution is prepared as described. The printer here had time both to keep the prints in motion and to carefully and critically examine each one, which he did by transmitted light, holding it up against a gas flame before him. The average time for a print to acquire a purple black tone is about from eight to ten minutes. During these various operations the prints were kept almost invariably face down in the various solutions.

The fixing bath consists of three ounces of hypsulphite of soda to the pint of water. The best quality of soda procurable, although costing somewhat more than that of average quality, is alone employed, as it is found cheapest in the long run, and Mr. Midwinter has been taught by experience that ten minutes in a solution of the above strength is sufficient to insure the prints being thoroughly fixed. They are then washed for two hours in running water.

Let us pause for a moment to speak of the influence exerted by a bad sample of hypo upon the future of a print. Only a short time ago there was a perfect epidemic of spots on albumenized prints. Complaints respecting this reached us almost daily and from

sources widely apart. No matter what care was taken or what brand of albumenized paper was employed, the plague prevailed. An observant professional friend in the North found that the prevalence of the spots in his case was concurrent with his using a certain kind of hypo which he had recently purchased. Acting on a surmise, he made two fixing baths, one with an old and the other with the new purchase. A brief period sufficed to establish the fact that the spots were attributable exclusively to the soda most recently procured. How it acted he could not tell; but that, in his case at any rate, it was the cause of the spotted prints he felt well assured. The subsequent employment of another sample insured freedom from all farther annoyance. We have written this *apropos* of Mr. Midwinter's care in using anything but the best quality of hypo.

With regard to the toning bath, forty-eight grains of gold for toning forty-two sheets of paper, and toning them well, cannot be considered otherwise than as being strictly economical. This, we were informed, is the proportion indicated by experience. There was no meanness or defects of like nature apparent in any of the work done under the conditions described; indeed, we were told that such is altogether unknown.

The mounting is performed in the manner in common practice by many, that is, the prints are taken from the water and piled, face down, one on the top of the other. The surplus water is removed by gentle pressure on the top, but not to such an extent as to cause adhesion between them; starch is applied to the top one, which is then attached to the mount, and so on to the end. After spotting, they are placed in a grooved box, to remain for burnishing, which is done the next morning. The grooved box has a perforated zinc bottom and a drawer below in which two or more wet sponges are contained, the object being to prevent the prints becoming quite desiccated, which is inimical to their ultimately taking on the highest finish.

The burnisher, which acts the part rather of a hot roller than a burnisher pure and simple, is one of that form known as the quadruplex enameler, made by a Chicago firm. Having been passed through this a few times, the prints acquire a high glaze and finish; and, to prevent any curling, they are laid, face down, on a wooden table until cold; when taken up, they are quite flat. No lubricant is employed.

In the foregoing remarks we have given, in as brief a manner as possible, an account of the way in which we saw many gems of pictorial art produced. It is, however, proper that we should say that the negatives are pictorially and technically of great excellence. The former is doubtless owing to the fact that Mr. Midwinter, previous to becoming a photographer, had, on his return from the Crimean war, through which he had passed, gone in for an art education and graduated as a painter; the latter is a consequence of care, method, and a knowledge of what a photograph should be.

Before leaving, we had a look over the studio and adjoining rooms. The studio has a "lean-to" roof, fitted with double, nay, with quadruple spring roller blinds, one pair of white and blue overlapping each other, and either of them capable of being raised or let down. There is also a side vertical light, looking on a garden, the wall of which, with its trailing plants and boulders, seems well adapted for the posing of large groups against.

Mr. Harvey, the operator, a near relative of the proprietor, who has been since youth with the firm, seems to have the art of lighting and posing the sitter at his fingers' ends; for, in an incredibly short period, he manipulated the screens so as to produce any effect desired. The reception and adjoining rooms are decorated with the choicest examples of Mr. Midwinter's work, and form quite an exhibition in itself.

The prices at this establishment are: 1*l.* a dozen for cabinets; 3*0s.* for boudoirs; 2*l.* 2*s.* for imperials; and 3*l.* 12*s.* for panels.

In connection with the finishing of gelatino-chloride prints, we have been shown some examples of a method adopted by Mr. W. Crooke, of Edinburgh, which imparts to the surface a delicate matt that for many purposes has a charming effect. We have not been apprised of the method employed in producing this matt, although the paper is of the same brand as that used by Mr. Midwinter. From some experiments of our own, however, since made, by interposing a film of matt celluloid between the burnisher and the photograph, which imparts the effect in question, we may suppose Mr. Crooke's method must bear some resemblance to this.—*British Journal of Photography*.

THE *Iron Industry Gazette* complains that inventors are not, in these days, doing much that is important in the line of ironworking machines. Do they, asks the editor, consider these machines too nearly perfect to offer a profitable margin for work? Any practical ironworker can give the inventor an idea of improvements that are possible. The inventors ought not to turn from so important a field as this. It is not yet closed by any means.