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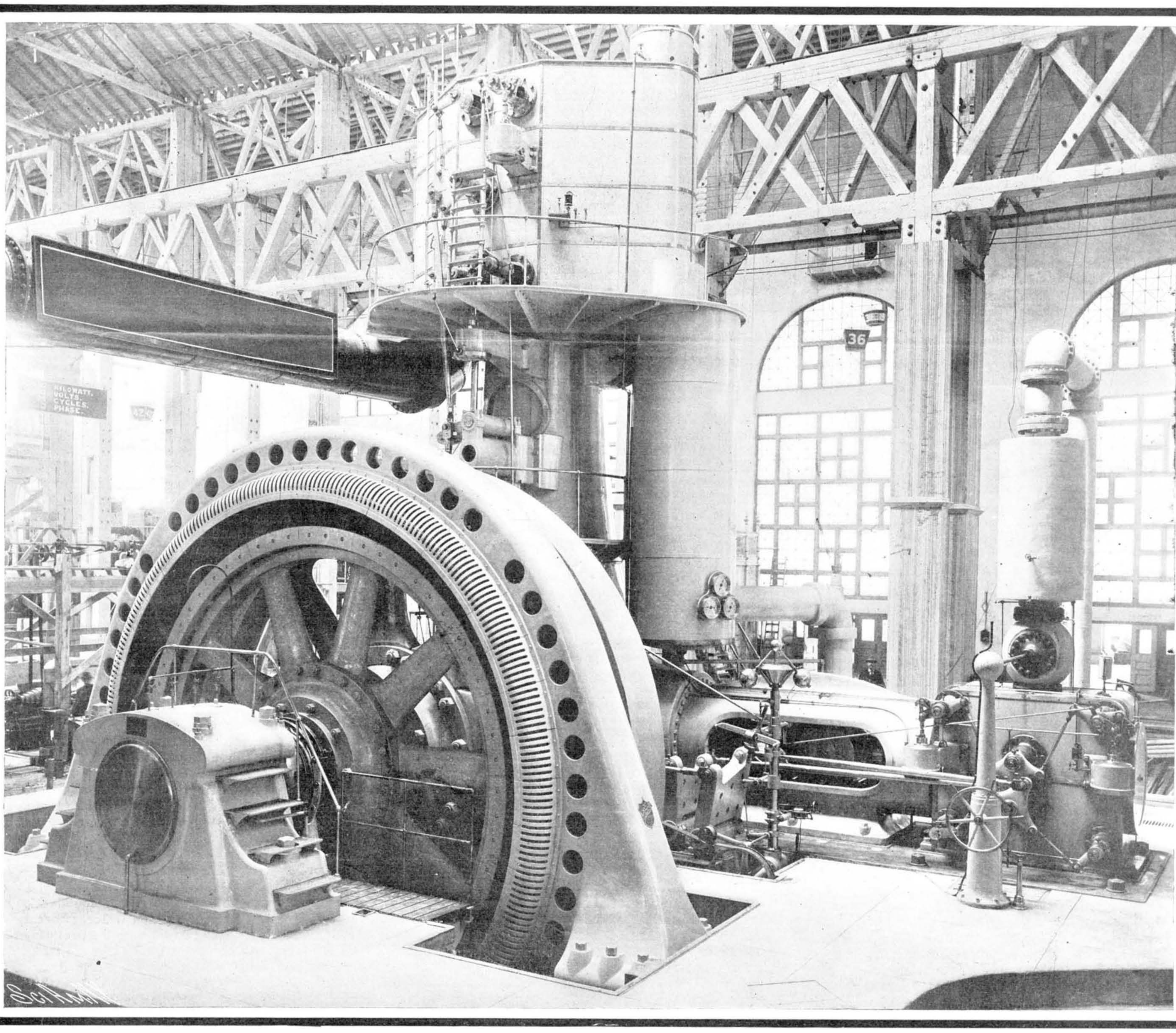
THE BIG ENGINE OF THE ST. LOUIS EXPOSITION AND THE ILLUMINATION OF THE BUILDINGS.

By the St. Louis Correspondent of the SCIENTIFIC AMERICAN.

IN the center of Machinery Hall at the St. Louis Exposition, there towers up above the surrounding exhibits the splendid 5,000-horse-power Allis-Chalmers engine and Bullock electric generator, which hold the same position in the present fair as did the big Corliss in the Centennial Exposition.

This big steam-electric unit forms an important part of the operating plant of the Exposition, its special densing type. The high-pressure cylinder, which is horizontal, is 45 inches in diameter and the vertical low-pressure cylinder is 94 inches in diameter. They have a common stroke of 60 inches, and connect to a common crank pin, the center line of the cylinders being set at 90 degrees. In the high-pressure cylinder the valves are set in the cylinder, and valves and cylinder are double ported. In the low-pressure cylinder the valves are set in the heads. The high-pressure piston rod is 9 inches in diameter, the low-pressure rod 10 inches in diameter. The shaft is hollow-forged of open-hearth steel, with a diameter of 37 inches in the wheel and generator fits. The main bearing measures erated. The stator yoke measures 33 feet over all and weighs 29 tons. From the above particulars it will be seen what a magnificent specimen of a modern reciprocating engine this splendid machine is, and it is worthy of note that the engine and generator, which were built at different cities, and shipped to the Exposition, were put together without the slightest hitch, and without the construction of any special erecting machinery.

Regarding the generator, it should be mentioned that it has attained a regulation within 6 per cent—a truly remarkable record. The engine, moreover, can be regulated within 2 per cent, thus providing a steam electric unit which in this respect has certainly never



THE 5,000-HORSE-POWER ENGINE AND GENERATOR USED IN ILLUMINATING THE GROUNDS OF THE LOUISIANA PURCHASE EXPOSITION.

duty being to furnish the electric current for the decorative lighting for the Exposition grounds and buildings. The magnitude of the task is understood when it is stated that over 120,000 eight-candle incandescent lamps depend for their current upon this particular engine. The unit is remarkable, not merely as being the largest in the Exposition, but as being the largest single engine ever constructed. Furthermore, in view of the splendid results which are being attained by the steam turbine, the coming motor for such work, this is probably the largest single reciprocating engine that will ever be constructed. The type is known as Reynolds combined vertical and horizontal compound con-

34 inches by 60 inches and the outer bearing 32 inches by 48 inches. The crank pin, which is of nickel steel, is 20 inches in diameter and 18 inches long, being common to both high and low pressure engines. The flywheel is 25 feet in diameter, the rim being 30 inches on the face and 32 inches deep. The engine extends in height about 40 feet above the foundation and its whole weight is 720 tons. The flywheel weighs 150 tons, the shaft 30½ tons, the crank 16 tons, and the total weight of the revolving parts, including the generator, is 257¼ tons. The generator has a rated capacity of 3,500 kilowatts. The normal speed of revolution is 75 per minute and 3-phase 6,600-volt current is gen-

been surpassed. Curve sheets of tests show efficiencies for this type of generator of 90.3 under quarter load, 94.6 under half load, 96.7 under whole load and 97.1 under 50 per cent overload. The fields of the generator are energized by a separate exciter operated by a 300-horse-power engine.

One of the most charming spectacles at the Exposition is that of the gradual brightening of the lines of electric lights at dusk, when the architectural beauties of the Fair are gradually reproduced in delicate lines of light. The first indication is a faint glow of red not unlike the last tinge of a summer sunset, which softly outlines the familiar form of the various

buildings. Slowly these lines brighten, until the whole picture glows with fire, and then, as the full current begins to tell, the lines of light brighten into brilliant incandescence and the picture is complete.

This gradual bringing up of the illumination is done by means of a rheostat, whose purpose is to absorb the current created by the exciter for the generator of the big engine, and hold it back until it is wanted. Upon its face is an arm which revolves upon a large number of pieces of copper; and as this makes a turn, it cuts out bit by bit the resistance of the rheostat. The arm of the rheostat is turned by a little electric motor, mounted upon the top of the cage, and when the time for lighting up arrives, the motor is set in operation. As the resistance is gradually cut out, the whole of the 120,000 lamps scattered throughout the grounds of the entire Fair begin to brighten feebly, but at the same rate of intensity. The whole operation can be watched by visitors to the Fair, since the Machinery Building is open for inspection after dark.

[Concluded from SUPPLEMENT No. 1488, page 23843.]

THE DISCOVERY OF THE FUTURE.*

By H. G. WELLS.

I MUST confess that I believe quite firmly that an inductive knowledge of a great number of things in the future is becoming a human possibility. I believe that the time is drawing near when it will be possible to suggest a systematic exploration of the future. And you must not judge the practicability of this enterprise by the failures of the past. So far nothing has been attempted, so far no first-class mind has ever focused itself upon these issues; but suppose the laws of social and political development, for example, were given as many brains, were given as much attention, criticism, and discussion as we have given to the laws of chemical combination during the last fifty years, what might we not expect?

To the popular mind of to-day there is something very difficult in such a suggestion, soberly made. But here, in this institution which has watched for a whole century over the splendid adolescence of science, and where the spirit of science is surely understood, you will know that as a matter of fact prophecy has always been inseparably associated with the idea of scientific research. The popular idea of scientific investigation is a vehement, aimless collection of little facts, collected as the bower bird collects shells and pebbles, in methodical little rows, and out of this process, in some manner unknown to the popular mind, certain conjuring tricks—the celebrated wonders of science—in a sort of accidental way emerge. The popular conception of all discovery is accident. But you will know that the essential thing in the scientific process is not the collection of facts, but the analysis of facts. Facts are the raw material and not the substance of science. It is analysis that has given us all ordered knowledge, and you know that the aim and the test and the justification of the scientific process is not a marketable conjuring trick, but prophecy. Until a scientific theory yields confident forecasts you know it is unsound and tentative; it is mere theorizing, as evanescent as art talk or the phantoms politicians talk about. The splendid body of gravitational astronomy, for example, establishes itself upon the certain forecast of stellar movements, and you would absolutely refuse to believe its amazing assertions if it were not for these same unerring forecasts. The whole body of medical science aims, and claims the ability, to diagnose. Meteorology constantly and persistently aims at prophecy, and it will never stand in a place of honor until it can certainly foretell. The chemist forecasts elements before he meets them—it is very properly his boast—and the splendid manner in which the mind of Clerk Maxwell reached in front of all experiment and foretold those things that Marconi has materialized is familiar to us all.

And if I am right in saying that science aims at prophecy, and if the specialist in each science is in fact doing his best now to prophesy within the limits of his field, what is there to stand in the way of our building up this growing body of forecast into an ordered picture of the future that will be just as certain, just as strictly science, and perhaps just as detailed as the picture that has been built up within the last hundred years to make the geological past? Well, so far and until we bring the prophecy down to the affairs of man and his children, it is just as possible to carry induction forward as back; it is just as simple and sure to work out the changing orbit of the earth in the future until the tidal drag hauls one unchanging face at last toward the sun as it is to work back to its blazing and molten past. Until man comes in, the inductive future is as real and convincing as the inductive past. But inorganic forces are the smaller part and the minor interest in this concern. Directly man becomes a factor the nature of the problem changes, and our whole present interest centers on the question whether man is, indeed, individually and collectively incalculable, a new element which entirely alters the nature of our inquiry and stamps it at once as vain and hopeless, or whether his presence complicates, but does not alter, the essential nature of the induction. How far may we hope to get trustworthy inductions about the future of man?

Well, I think, on the whole, we are inclined to underrate our chance of certainties in the future, just as I think we are inclined to be too credulous about the historical past. The vividness of our personal memories, which are the very essence of reality to us, throws a glamor of conviction over tradition and past inductions. But the personal future must in the very nature of things be hidden from us so long as time endures, and this black ignorance at our very feet—this black shadow that corresponds to the brightness of our memories behind us—throws a glamor of uncertainty and unreality over all the future. We are continually surprising ourselves by our own will or want of will; the individualities about us are continually producing the unexpected, and it is very natural to reason that as we can never be precisely sure before the time comes what we are going to do and feel, and if we can never count with absolute certainty upon the acts and happenings even of our most intimate friends, how much the more impossible is it to anticipate the behavior in any direction of states and communities.

In reply to which I would advance the suggestion that an increase in the number of human beings considered may positively simplify the case instead of complicating it; that as the individuals increase in number they begin to average out. Let me illustrate this point by a comparison. Angular pit sand has grains of the most varied shapes. Examined microscopically, you will find all sorts of angles and outlines and variations. Before you look you can say of no particular grain what its outline will be. And if you shoot a load of such sand from a cart you cannot foretell with any certainty where any particular grain will be in the heap that you make; but you can tell—you can tell pretty definitely—the form of the heap as a whole. And further, if you pass that sand through a series of shoots and finally drop it some distance to the ground, you will be able to foretell that grains of a certain sort of form and size will for the most part be found in one part of the heap and grains of another sort of form and size will be found in another part of the heap. In such a case, you see, the thing as a whole may be simpler than its component parts, and this I submit is also the case in many human affairs. So that because the individual future eludes us completely that is no reason why we should not aspire to, and discover and use, safe and serviceable generalizations upon countless important issues in the human destiny.

But there is a very grave and important-looking difference between a load of sand and a multitude of human beings, and this I must face and examine. Our thoughts and wills and emotions are contagious. An exceptional sort of sand grain, a sand grain that was exceptionally big and heavy, for example, exerts no influence worth considering upon any other of the sand grains in the load. They will fall and roll and heap themselves just the same whether that exceptional grain is with them or not; but an exceptional man comes into the world, a Cæsar or a Napoleon or a Peter the Hermit, and he appears to persuade and convince and compel and take entire possession of the sand heap—I mean the community—and to twist and alter its destinies to an almost unlimited extent. And if this is indeed the case, it reduces our project of an inductive knowledge of the future to very small limits. To hope to foretell the birth and coming of men of exceptional force and genius is to hope incredibly, and if, indeed, such exceptional men do as much as they seem to do in warping the path of humanity, our utmost prophetic limit in human affairs is a conditional sort of prophecy. If people do so and so, we can say, then such and such results will follow, and we must admit that that is our limit.

But everybody does not believe in the importance of the leading man. There are those who will say that the whole world is different by reason of Napoleon. But there are those who believe entirely in the individual man and those who believe entirely in the forces behind the individual man, and for my own part I must confess myself a rather extreme case of the latter kind. I must confess I believe that if by some juggling with space and time Julius Cæsar, Napoleon, Edward IV., William the Conqueror, Lord Rosebery, and Robert Burns had all been changed at birth it would not have produced any serious dislocation of the course of destiny. I believe that these great men of ours are no more than images and symbols and instruments taken, as it were, haphazard by the incessant and consistent forces behind them; they are the pen nibs Fate has used for her writing, the diamonds upon the drill that pierces through the rock. And the more one inclines to this trust in forces the more one will believe in the possibility of a reasoned inductive view of the future that will serve us in politics, in morals, in social contrivances, and in a thousand spacious ways. And even those who take the most extreme and personal and melodramatic view of the ways of human destiny, who see life as a tissue of fairy godmother births and accidental meetings and promises and jealousies, will, I suppose, admit there comes a limit to these things—that at last personality dies away and the greater forces come to their own. The great man, however great he be, can not set back the whole scheme of things; what he does in right and reason will remain and what he does against the greater creative forces will perish. We can not foresee him; let us grant that. His personal difference, the splendor of his effect, his dramatic arrangement of events will be his own—in other words, we can not estimate for accidents and accelerations and delays; but if only we throw our web of generalization wide enough, if only we spin our rope of induction strong enough, the final result of the great man, his ultimate surviving consequences, will come within our net.

Such, then, is the sort of knowledge of the future that I believe is attainable and worth attaining. I believe that the deliberate direction of historical study and of economic and social study toward the future, and an increasing reference, a deliberate and courageous reference, to the future in moral and religious discussion, would be enormously stimulating and enormously profitable to our intellectual life. I have done my best to suggest to you that such an enterprise is now a serious and practicable undertaking. But at the risk of repetition I would call your attention to the essential difference that must always hold between our attainable knowledge of the future and our existing knowledge of the past. The portion of the past that is brightest and most real to each of us is the individual past—the personal memory. The portion of the future that must remain darkest and least accessible is the individual future. Scientific prophecy will not be fortune telling, whatever else it may be. Those excellent people who cast horoscopes, those illegal fashionable palm-reading ladies who abound so much to-day, in whom nobody is so foolish as to believe, and to whom everybody is foolish enough to go, need fear no competition from the scientific prophets. The knowledge of the future we may hope to gain will be general and not individual; it will be no sort of knowledge that will either hamper us in the exercise of our individual free will or relieve us of our personal responsibility.

And now, how far is it possible at the present time to speculate on the particular outline the future will assume when it is investigated in this way?

It is interesting, before we answer that question, to take into account the speculations of a certain sect and culture of people who already, before the middle of last century, had set their faces toward the future as the justifying explanation of the present. These were the positivists, whose position is still most eloquently maintained and displayed by Mr. Frederic Harrison, in spite of the great expansion of the human outlook that has occurred since Comte. If you read Mr. Harrison, and if you are also, as I presume your presence here indicates, saturated with that new wine of more spacious knowledge that has been given the world during the last fifty years, you will have been greatly impressed by the peculiar limitations of the positivist conception of the future. So far as I can gather, Comte was, for all practical purposes, totally ignorant of that remoter past outside the past that is known to us by history, or if he was not totally ignorant of its existence, he was, and conscientiously remained, ignorant of its relevancy to the history of humanity. In the narrow and limited past he recognized men had always been like the men of to-day; in the future he could not imagine that they would be anything more than men like the men of to-day. He perceived, as we all perceive, that the old social order was breaking up, and after a richly suggestive and incomplete analysis of the forces that were breaking it up he set himself to plan a new static social order to replace it. If you will read Comte, or, what is much easier and pleasanter, if you will read Mr. Frederic Harrison, you will find this conception constantly apparent—that there was once a stable condition of society with humanity, so to speak, sitting down in an orderly and respectable manner; that humanity has been stirred up and is on the move, and that finally it will sit down again on a higher plane, and for good and all, cultured and happy, in the reorganized positivist state. And since he could see nothing beyond man in the future, there, in that millennial fashion, Comte had to end. Since he could imagine nothing higher than man, he had to assert that humanity, and particularly the future of humanity, was the highest of all conceivable things.

All that was perfectly comprehensible in a thinker of the first half of the nineteenth century. But we of the early twentieth, and particularly that growing majority of us who have been born since the Origin of Species was written, have no excuse for any such limited vision. Our imaginations have been trained upon a past in which the past that Comte knew is scarcely more than the concluding moment. We perceive that man, and all the world of men, is no more than the present phase of a development so great and splendid that beside this vision epics jingle like nursery rhymes, and all the exploits of humanity shrivel to the proportion of castles in the sand. We look back through countless millions of years and see the great will to live struggling out of the intertidal slime, struggling from shape to shape and from power to power, crawling and then walking confidently upon the land, struggling generation after generation to master the air, creeping down into the darkness of the deep; we see it turn upon itself in rage and hunger and reshape itself anew; we watch it draw nearer and more akin to us, expanding, elaborating itself, pursuing its relentless, inconceivable purpose, until at last it reaches us and its being beats through our brains and arteries, throbs and thunders in our battleships, roars through our cities, sings in our music, and flowers in our art. And when, from that retrospect, we turn again toward the future, surely any thought of finality, any millennial settlement of cultured persons, has vanished from our minds.

This fact that man is not final is the great unmanageable, disturbing fact that arises upon us in the scientific discovery of the future, and to my mind, at any rate, the question what is to come after man is the most persistently fascinating and the most insoluble question in the whole world.

Of course we have no answer. Such imaginations as we have refuse to rise to the task.

But for the nearer future, while man is still man, there are a few general statements that seem to grow

* A discourse delivered at the Royal Institution.

more certain. It seems to be pretty generally believed to-day that our dense populations are in the opening phase of a process of diffusion and aeration. It seems pretty inevitable also that at least the mass of white population in the world will be forced some way up the scale of education and personal efficiency in the next two or three decades. It is not difficult to collect reasons for supposing—and such reasons have been collected—that in the near future, in a couple of hundred years, as one rash optimist has written, or in a thousand or so, humanity will be definitely and conscientiously organizing itself as a great world state—a great world state that will purge from itself much that is mean, much that is bestial, and much that makes for individual dullness and dreariness, grayness and wretchedness in the world of to-day; and although we know that there is nothing final in that world state, although we see it only as something to be reached and passed, although we are sure there will be no such sitting down to restore and perfect a culture as the positivists foretell, yet few people can persuade themselves to see anything beyond that except in the vaguest and more general terms. That world state of more efficient, more vivid, beautiful, and eventful people is, so to speak, on the brow of the hill, and we can not see over, though some of us can imagine great uplands beyond and something, something that glitters elusively, taking first one form and then another, through the haze. We can see no detail, we can see nothing definable, and it is simply, I know, the sanguine necessity of our minds that makes us believe those uplands of the future are still more gracious and splendid than we can either hope or imagine. But of things that can be demonstrated we have none.

Yet I suppose most of us entertain certain necessary persuasions, without which a moral life in this world is neither a reasonable nor a possible thing. All this paper is built finally upon certain negative beliefs that are incapable of scientific establishment. Our lives and powers are limited, our scope in space and time is limited, and it is not unreasonable that for fundamental beliefs we must go outside the sphere of reason and set our feet upon faith. Implicit in all such speculations as this, is a very definite and quite arbitrary belief, and that belief is that neither humanity nor in truth any individual human being is living its life in vain. And it is entirely by an act of faith that we must rule out of our forecasts certain possibilities, certain things that one may consider improbable and against the chances, but that no one upon scientific grounds can call impossible. One must admit that it is impossible to show why certain things should not utterly destroy and end the entire human race and story, why night should not presently come down and make all our dreams and efforts vain. It is conceivable, for example, that some great unexpected mass of matter should presently rush upon us out of space, whirl sun and planets aside like dead leaves before the breeze, and collide with and utterly destroy every spark of life upon this earth. So far as positive human knowledge goes, this is a conceivably possible thing. There is nothing in science to show why such thing should not be. It is conceivable, too, that some pestilence may presently appear, some new disease, that will destroy, not 10 or 15 or 20 per cent of the earth's inhabitants as pestilences have done in the past, but 100 per cent, and so end our race. No one, speaking from scientific grounds alone, can say, "That can not be." And no one can dispute that some great disease of the atmosphere, some trailing cometary poison, some great emanation of vapor from the interior of the earth, such as Mr. Shiel has made a brilliant use of in his "Purple Cloud," is consistent with every demonstrated fact in the world. There may arise new animals to prey upon us by land and sea, and there may come some drug or a wrecking madness into the minds of men. And finally, there is the reasonable certainty that this sun of ours must some day radiate itself toward extinction; that, at least, must happen; it will grow cooler and cooler, and its planets will rotate ever more sluggishly until some day this earth of ours, tideless and slow moving, will be dead and frozen, and all that has lived upon it will be frozen out and done with. There surely man must end. That of all such nightmares is the most insistently convincing.

And yet one doesn't believe it.

At least I do not. And I do not believe in these things because I have come to believe in certain other things—in the coherency and purpose in the world and in the greatness of human destiny. Worlds may freeze and suns may perish, but there stirs something within us now that can never die again.

Do not misunderstand me when I speak of the greatness of human destiny.

If I may speak quite openly to you, I will confess that, considered as a final product, I do not think very much of myself or (saving your presence) my fellow-creatures. I do not think I could possibly join in the worship of humanity with any gravity or sincerity. Think of it. Think of the positive facts. There are surely moods for all of us when one can feel Swift's amazement that such a being should deal in pride. There are moods when one can join in the laughter of Democritus; and they would come oftener were not the spectacle of human littleness so abundantly shot with pain. But it is not only with pain that the world is shot—it is shot with promise. Small as our vanity and carnality make us, there has been a day of still smaller things. It is the long ascent of the past that gives the lie to our despair. We know now that all the blood and passion of our life were represented in the Carboniferous time by something—something, perhaps, coldblooded and with a clammy skin, that lurked between air and water, and fled before the giant amphibia of those days.

For all the folly, blindness, and pain of our lives, we have come some way from that. And the distance we have traveled gives us some earnest of the way we have yet to go.

Why should things cease at man? Why should not this rising curve rise yet more steeply and swiftly? There are many things to suggest that we are now in a phase of rapid and unprecedented development. The conditions under which men live are changing with an ever-increasing rapidity, and, so far as our knowledge goes, no sort of creatures have ever lived under changing conditions without undergoing the profoundest changes themselves. In the past century there was more change in the conditions of human life than there had been in the previous thousand years. A hundred years ago inventors and investigators were rare scattered men, and now invention and inquiry are the work of an unorganized army. This century will see changes that will dwarf those of the nineteenth century, as those of the nineteenth dwarf those of the eighteenth. One can see no sign anywhere that this rush of change will be over presently, that the positivist dream of a social reconstruction and of a new static culture phase will ever be realized. Human society never has been quite static, and it will presently cease to attempt to be static. Everything seems pointing to the belief that we are entering upon a progress that will go on, with an ever-widening and ever more confident stride, forever. The reorganization of society that is going on now beneath the traditional appearance of things is a kinetic reorganization. We are getting into marching order. We have struck our camp forever and we are out upon the roads.

We are in the beginning of the greatest change that humanity has ever undergone. There is no shock, no epoch-making incident—but then there is no shock at a cloudy daybreak. At no point can we say, "Here it commences, now; last minute was night and this is morning." But insensibly we are in the day. If we care to look, we can foresee growing knowledge, growing order, and presently a deliberate improvement of the blood and character of the race. And what we can see and imagine gives us a measure and gives us faith for what surpasses the imagination.

It is possible to believe that all the past is but the beginning of a beginning, and that all that is and has been is but the twilight of the dawn. It is possible to believe that all that the human mind has ever accomplished is but the dream before the awakening. We can not see, there is no need for us to see, what this world will be like when the day has fully come. We are creatures of the twilight. But it is out of our race and lineage that minds will spring, that will reach back to us in our littleness to know us better than we know ourselves, and that will reach forward fearlessly to comprehend this future that defeats our eyes. All this world is heavy with the promise of greater things, and a day will come, one day in the unending succession of days, when beings, beings who are now latent in our thoughts and hidden in our loins, shall stand upon this earth as one stands upon a footstool, and shall laugh and reach out their hands amid the stars.

THE WARD-COONLEY COLLECTION OF METEORITES.*

By L. P. GRATACAP.

THE catalogue prepared by Prof. Henry A. Ward, of Rochester (now Chicago), gives pre-eminence over all the collections of meteorites in the country to the remarkable assemblage of specimens it records and describes. It is a superb piece of letter-press work, and the industry exhibited in its compilation, the ingenuity and scientific thoughtfulness with which the various aspects of the collection are displayed in it, place its author also among the eminent students of this subject.

A glance only through its pages shows that the Ward-Coonley collection of meteorites has an international eminence, and that it to-day demands consideration alongside of the great cabinets of Vienna, Paris, London, and Berlin. It was fully expected by those familiar with Prof. Ward's intention to issue this exhaustive statement, that the publication would equal in interest the collection itself, as a contribution to contemporaneous scientific literature. Recent papers by the author, notably his admirable studies of the Bacubirito iron in Mexico, and the anomalous Willamette iron in Oregon, justified this expectation, as well as the author's own well-known insatiable enthusiasm. But it can be safely said that, among his admirers, few looked for such a sumptuous presentation of the contents of this great collection.

The few pages of prefatory matter, which it is a matter of regret were not made more extended, tell us of the growth of this cabinet, and intimate the untiring industry, the subtle care, and the resourceful energy of its collector. Prof. Ward has literally ransacked the earth to make additions to this collection, and has placed under contribution his characteristic wit and address to increase its number of "falls." It was not many years ago (1899) that Prof. Ward took a 300-mile ride from Enzeli, a little port on the Caspian Sea, to Teheran, Persia, on the almost hopeless mission of securing a portion of the *Veramin* meteorite, then exhibited in the museum hall in the palace of the Shah. And he succeeded. He visited Riga, Dorpat, Reval, in the Baltic provinces, hunting meteoritic prizes, and he then obtained the valuable *Misshof* and *Tennasilm* aerolites. And this ceaseless quest has been continued year after year.

The readers of the SCIENTIFIC AMERICAN need not be reminded of his zeal in recently (1902) making his way to the distant State of Sinaloa, Mexico, to locate, describe, and "sample" the huge iron mass at Bacubirito; and under very considerable discomforts, at a very unseasonable period, he undertook the same task with that most remarkable of known irons, the siderite of Willamette, Oregon.

Every phase of meteorite collection has been studied by Prof. Ward. His knowledge of all the existing collections is complete, and his intimacy with the physical features of the various "falls" quite as remarkable.

The history of the growth of the Ward-Coonley collection is interesting, because of the rapidity of its increase. When Prof. Ward left America in 1898, the collection (then his own private collection) numbered about 200 localities. He had not been abroad many months when he had raised this to 352, and it now (under the guise of the Ward-Coonley collection) has reached the total of 603 falls.

In this work, lavish expenditure of money, personal enterprise in reaching rare or virgin falls, and exchange, have been the means of acquisition. In his most interesting preface (how willingly the reader would have had it lengthened to twice the size) the professor tells us: "This matter of exchange becomes thus the base and *vis viva* of nearly all acquisitions of subsequent already known kinds. The way in which the maker of the Ward-Coonley collection has applied this force is simple in statement, yet not altogether easy in execution. He has sought in a combination of money with extensive travel to continually obtain each year some new kinds which no other collection possessed. These he sought in all the continents, wherever there was sure promise of obtaining them. Japan, Java, India, Australia, Persia, Siberia, South Africa, South and Central America, have each responded to his quest, yielding him new and precious kinds with which to obtain from other museums meteorite rarities which no money would dislodge, and which were nowhere else obtainable. With some of these rarities always with him, he has visited every important meteorite collection in the world, most of them many times over in successive years. In all this the power of exchange as a force in building a meteorite collection has been carried to its extreme limit." The writer recalls the amusing circumstance that when Prof. Ward was carrying his trunks full of exchange meteoritic material, in Russia, the custom house officials viewed them with suspicion, until persuaded to allow them free entrance and exit, under the problematical designation of "astronomical instruments."

The catalogue itself mentions the recent growth of the collection:

Catalogue of 1900, 424 falls; weight, 1,399 kilos.
Catalogue of 1901, 511 falls; weight, 1,786 kilos.
Catalogue of 1904, 603 falls; weight, 2,495 kilos.

In its arrangement the catalogue contains first the iron meteorites, or siderites, arranged in alphabetical order, with a brief table of the chronology of those seen to fall, and a statement of when found or described, exact locality, if determinable; original description and weight, both of the largest piece and total weight of all pieces. The half-irons, siderolites, follow, and after them the stones or aerolites. A table of synonyms is given, a very useful feature, which is succeeded by a table of the geographical distribution of all known meteorites. This is succeeded by the publication of Dr. Brezina's system of meteorite classification, a very much elaborated and highly interesting, though perhaps somewhat precarious taxonomic guide.

The summary establishes the importance and pre-eminence of the collection:

Total number of falls and finds (siderites, 241; siderolites, 28; aerolites, 334)	603
From North America	229
From South America	31
From Europe	213
From Asia	77
From Africa	27
From Australasia and Sandwich Islands	26
Total weight of entire collection	5,509 pounds
Total number of specimens, about	1,600

This notice could very easily be extended to a very considerable degree, if the features of this collection, as they strike the notice of a visitor, were dwelt upon. It is placed on deposit in the Geological Hall of the American Museum of Natural History in this city, and its inspection will repay every visitor with pleasure and instruction.

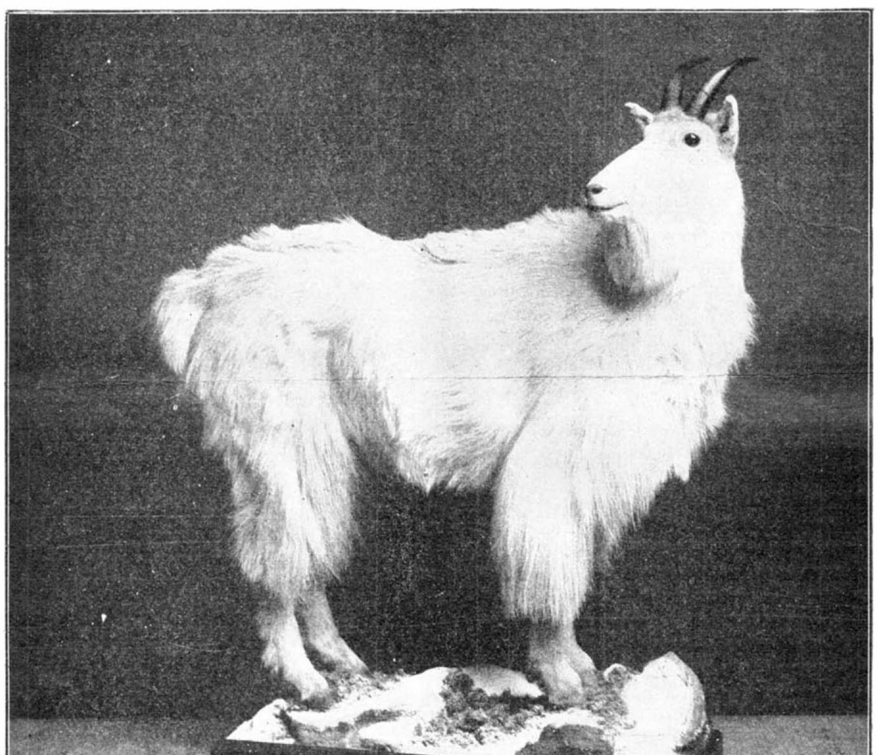
Besides the original specimens, the collection contains a large series of casts, adjunct material, medals, and coins (*betyl*) struck off in commemoration of "falls," among the ancients. Eight well-executed plates close this most meritorious publication.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

American Sulphur Wanted in France.—Referring to a new source of sulphur production reported in Louisiana, I shall be glad to receive such information as will enable me to place correspondents in touch with the proper sources of supply of sulphur in the United States.—Robert P. Skinner, Consul-General, Marseilles, France.

THE WHITE GOAT.

One of the most striking models prepared by the government for exposition purposes is the white goat, which is also known as the goat antelope. The model formed a part of a series of large American Arctic and sub-Arctic animals, including the musk-ox of the barren grounds of Canada and the far West. Our illustration is taken from the report of the United States National Museum.



THE WHITE GOAT.

HEALTH CONDITIONS ON THE ISTHMUS OF PANAMA.*

By Dr. W. C. Gorgas, Assistant Surgeon-General, United States Army.

I have just returned from looking over the ground at Panama, along the route of the proposed Isthmian canal. I went down with the Isthmian Canal Commission, at their request, for the purpose of getting some idea of the present sanitary conditions, and of formulating for them some general plan of sanitation.

As some of your readers may not be familiar with the literature concerning the Panama Canal, or with the character of the country through which the canal passes, a rough description will probably be of interest, and make my remarks the more easily understood. The Isthmus, at this point, runs in a general direction from east to west, and the canal route generally from north to south. The town of Colon is the northern terminus of the canal, on the Caribbean Sea, and the town of Panama the southern terminus, on the Pacific Ocean. The great chain of mountains which extends through North, Central, and South America, has at this point about its least elevation, the highest point of the divide through which the canal runs being here about 500 feet. The country is generally volcanic in its formation, thickly studded with numerous peaks and ridges, from 300 to 800 feet high. I should describe it as being very hilly and well drained.

The canal, in general, follows the line of the Chagres River up to the divide at Culebra Cut, some ten or twelve miles from Panama, and from Culebra down to Panama, the valley of the Rio Grande River. These streams are not swampy in any sense of the term. The rivers mentioned above, of course, have a certain amount of low ground in their bottoms, but not more than a stream the same size in northern New York. Owing to the warm climate and heavy rainfall, mosquitoes can find, all the year round, abundant places for breeding, even in as well-drained a section as the route of the Panama Canal is.

Colon is built upon a coral island in Limon Bay, the island itself being slightly below the main level of the sea. The part of this island on which Colon is situated is artificial ground, having been filled in three or four feet. The rest of the island is still covered with swamp. This is the only point at which swamps of any great extent would have to be dealt with.

The canal strip, at present, I consider in the normal state for tropical regions, from a health point of view. The death rate would be very large for our country, probably running in the neighborhood of fifty per thousand. But this is the case in all tropical countries where malaria prevails.

I estimate that, at the present time, there are about 40,000 persons on the strip, 20,000 at Panama, 3,000 at Colon, and about 15,000 in the little towns along the canal route. Not considering the original Spanish settlements, the canal strip has now been occupied by the whites for about fifty years. The present railroad, which runs along the canal route, was finished about 1855. The next extensive occupation by the whites was in 1881 and subsequent years, when the French attempted to build the canal. The health history of the strip, for the last fifty years, has been exceedingly lugubrious. The death rate among the laborers on the railroad and the French on the canal has been enormous. But this has generally been the case where large bodies of unacclimated Europeans have been thrown into tropical countries. We had the same experience with our army during the Santiago campaign in Cuba, the French a very much worse experience during their military occupation of Santo Domingo, the Spaniards during their military occupation of Cuba, and there are numerous other examples which I could mention.

The records of the French hospitals showed that they suffered from most of the diseases to which man is heir. But their excessive mortality was caused by yellow fever and malaria, but principally from malaria. While my plan contemplates a sanitary organization a good deal such as resulted so successfully at Havana, the latter will, of course, have to be modified to some extent to meet the changed conditions at Panama. I would propose the ordinary health organization for the care of infectious and contagious diseases, such as we have in New York or any other American city, and I think there is no doubt that such diseases can be controlled as they are in New York or elsewhere. I feel confident of being able to eliminate yellow fever by the same methods that were so successfully adopted in Havana. But malaria, in my opinion, is the disease on which the success of our sanitary measures at Panama will depend. If we can control malaria, I feel very little anxiety about other diseases. If we do not control malaria, our mortality is going to be heavy.

The condition of our marines is a very good illustration of the present health status there. Since the middle of December we have had 450 marines camped on one of the hills of the divide. The location is excellent, the hill some 200 feet high, with a small area on top, not more than an acre, and perfectly drained. The men are as comfortably fixed up as circumstances will allow. During the four months from the middle of December to the middle of April, they have had 170 cases of malarial fever out of 450 men. None of them have been severe, just such ordinary cases of chills and fever as we have in southern United States. The men themselves, as a body, were robust and vigorous in appearance, of good color, and, evidently, had not been at all affected, deleteriously, by climatic conditions. Nevertheless, we see here, that with a body of men under the most favorable conditions, one-third of them have become infected within four months. Now, if these men were our laborers, working daily in the Culebra Cut, exposed to the sun and weather, many of these cases would be severe in type, and, at the end of a year, we would be approaching the mortality of the French.

At the foot of this hill on which the marines are camped is a village of some 400 or 500 natives. When I say "natives," in speaking of the strip, I mean Jamaica negroes. I spent considerable time going through this village, questioning the natives, and examining the spleens of many of the children. All the children that I examined had very much enlarged spleens. This is considered an evidence of chronic malarial infection, and all the adults that I talked to spoke of having had attacks of chills and fever within the preceding six months. I accept this as evidence that this native population is very thoroughly infected with malaria, and I think our marines contract malaria from these natives. The marine, whenever off duty, spends his leisure hours, on the average, in the village. Every time he goes to the village he is bitten three or four times by mosquitoes, and occasionally one of these mosquitoes is an anopheles. This anopheles, having previously bitten some one of the infected natives, is herself infected, and gives the man malaria. The condition is very much the same as if four or five hundred natives had smallpox, and our marines had never been vaccinated. They would contract smallpox much as they are doing malaria now. I do not mean to say that the mosquito carries smallpox, but that the malaria originates with the natives and is transferred from them to the men, and that the natives are the cause of malaria, just as they would be the cause of smallpox.

If the population of this native village were removed, I think our men would very rapidly become free from malaria, under the supervision and direction of their medical officers. What I propose, is to take this village, put it under a systematic scheme of inspection whereby we shall be able to control all water barrels and deposits of water, so that no mosquitoes will be allowed to breed, look after its street cleaning and disposal of night soil, etc., so as to get it in good sanitary condition, then have the population examined and recorded, so that we shall have on a card a short history of each individual, and keep track of them in this way. Those suffering from malaria will be put under treatment, and watched as long as the malarial parasite is found in the blood. I hope, in this way, to decrease to the smallest limit the number of anopheles, the malaria-bearing mosquito, and, at the same time, to gradually eliminate the human being as a source of infection, so that at the end of a year it will be entirely safe for an unacclimated man to live in this village.

The above scheme of mosquito destruction was put into effect, on a large scale, at Havana, and, though entirely directed against yellow fever, was almost equally successful against malaria. The same measures that destroyed the stegomyia, the yellow fever mosquito, destroyed the anopheles, the malarial mosquito. The average death rate, for a number of years, from malaria, in Havana, was about 400. The year preceding the inauguration of our mosquito work we had 325 deaths from malaria. During the first year of mosquito work this was reduced to 150 deaths; the second year, 70 deaths; the third year, 50 deaths. In a small village, such as I have described, the mosquito work could, of course, be made very much more effective than in a large city of 300,000 inhabitants, and I am very confident that in the course of two or three years mosquito work alone would eliminate malaria in such a village.

We must, however, attain our results within a year, and, therefore, I would attempt, in addition, the freeing of human beings from malaria. This has been done successfully, on a small scale, in two or three instances, ~~notably by Koch,~~ in South Africa. The village above described is a fair example of what, in my opinion, will have to be done all along the strip. I have not described in detail the ordinary sanitary measures that will have to be adopted along the strip, and at the towns of Panama and Colon. Yellow fever, which, in the past, has been almost as fatal at Panama as malaria, will depend principally upon the sanitary work at Colon and Panama, and the quarantine arrangements for preventing its introduction. But this is in no way different, in my opinion, from the same problem at Havana, and the same measures there, I feel confident, will have the same results.

As to the safety of the individual in going to Panama at present, I think an intelligent man who will adopt the precaution of sleeping under a mosquito bar, such that mosquitoes could not get through, having sleeping quarters as much as possible away from the natives, and drinking boiled water, would be fairly safe.

I hear two opinions expressed with regard to the health of Panama. The general opinion, that one sees in the papers, is that it is almost fatal to live there, people expressing this opinion thinking that the conditions there now are exactly the same as when the French had fifteen or twenty thousand laborers on the work, and were losing by death and sickness a considerable proportion of this force every year. This is, of course, not true. The health conditions of Panama, at present, are not a bit worse than those of most other tropical countries. On the other hand, particularly down at Panama, you hear men talk as if it were a health resort. This is not so. The death rate now is large, as I said before, about like that of most tropical countries, and unless we can change conditions within the next year it will be far from a health resort, when our large force of laborers are on the ground and the work is in full swing. I recently saw an engineer, who had been on the ground for some time and was a man of considerable experience, quoted as saying that both the engineering and sanitary problems were simple and could be easily solved. Of the engineering problems I am no judge, but such statements with regard to the sanitary problems, by men of position and experience, I think are very rash and tend to do harm. In my opinion, the sanitary problems are grave. The question of eliminating yellow fever from an endemic focus has only been once before successfully managed, and that was at Havana. And, from this successful work, to argue that it is easy and simple, I think is not warranted. The malarial work, on the scale at Panama, is entirely new. It has never been attempted elsewhere, and any health officer who has had any experience in enforcing measures of individual prophylaxis, such as will be required at Panama, can understand how great the difficulties of administration will be. Personally, I believe it can be done, and I approach the work with great hope of success, but I know that it will be neither easy nor simple, that we will meet with many disappointments and have to modify our plans many times.

* Engineering Record.

LEATHER FROM ALLIGATOR SKINS.*

By Charles H. Stevenson.

Occasional attempts to utilize the coriaceous epidermis of alligators in leather manufacture have been made for one hundred years or more, but not with much success until about 1855, when this novel leather became somewhat fashionable and a considerable demand developed. The market, however, was not long continued, and after a few thousand hides had been shipped from the Gulf States the demand ended. During the civil war another raid was made upon these saurians to supply shoe material, and they were again slaughtered in thousands; but with the cessation of hostilities and the restoration of free commerce in shoe materials, the alligators were again left to repose for a period.

This rest, however, was only temporary, for about 1869 fickle fashion again called for the leather for manufacture into fancy slippers, boots, traveling bags, belts, card cases, music rolls, etc. An immense demand was soon created for it, resulting in the slaughter of many thousands of the animals every year, giving employment to hundreds of men. The demand soon exceeded the productive capacity of our own country, and large numbers of skins were imported from Mexico and Central America. The consumption of this leather at present is greater than ever before, and owing to the large importations the market price is somewhat less than a few years ago. The output of the tanneries of the United States approximates 280,000 skins annually, worth about $420,000. It is among the most characteristic of all aquatic leathers—indeed, of all leathers—being curiously checkered in oblong divisions, known as "scales" or "bosses," separated by intersecting grooves, and varying in size and character from the rough horn-like scutes on the back to smooth pliable markings on other parts of the body, giving the skin that peculiar effect which makes it so popular for leather purposes.

There are several distinct varieties of alligator skins on the markets, the most important being the Floridian, Louisianan, and Mexican; each differs from the others in certain well-defined characteristics, and owing to these differences each variety has its special uses.

The Florida skins are longer in the body—that is, from the fore legs to the hind legs—than those from Louisiana and Mexico, and consequently they are largely in demand by manufacturers of large handbags. They also have a number of so-called "buttons" or "corn marks" on the inside or under the surface of an equal number of the scutes, resulting from embedded horn-like tissues in the center of those scales. These increase the difficulty in tanning the skins and detract somewhat from the appearance of the finished article, and for this reason the Florida skins are ordinarily the cheapest on the market. The farther south the skins are secured in Florida the greater the number of "corn marks," and those from the vicinity of Key West are almost valueless on this account.

The Louisiana skins differ from those of Florida in the absence of the "corn marks" above noted, and from both the Florida and Mexican skins in being more pliable and in having the scales more artistically curved and shaped. Consequently they are preferred for such small articles as card cases and pocketbooks, and usually sell at the highest prices. Skins obtained in Mississippi and Texas are similar to those secured in Louisiana, while those from Georgia and South Carolina are similar to the Florida skins, except that the "corn markings" are not so numerous. All the Florida and Louisiana skins show greater uniformity of coloring, being of a bluish black on the upper surface and a peculiar bluish white on the under side.

In addition to an absence of the characteristics above noted, the Mexican and Central American skins are distinguished by having from 1 to 4 small dots or markings like pin holes near the caudal edge of each scale. The length of the Mexican skins varies greatly in proportion to the width, sometimes equaling that of the Florida skins. Those from the east coast of Mexico are the best, being lighter in color and with neat and attractively shaped scales. The west coast skins are yellowish in color when in the green state, and the scales are larger and not so artistically formed. The Florida and Louisiana skins are almost invariably split down the back, or rather along each side of the back, so as to preserve the under side in a solid piece, but most of the Mexican skins are split down the middle of the abdomen, keeping the back intact, making what is commonly known as "horn alligator."

On all of these hides the scales or bosses are far apart, without mutual articulation or overlapping. The number of nuchal scutes is usually four large ones, forming a square, separated on the median line, with a pair of small ones on front and another pair behind; there are 17 or 18 transverse series of dorsal scutes, the broadest series containing 8 scutes.

The skins of the alligators or caymans from Brazil, Venezuela, and other South American countries are distinguished by having a much heavier or more horny covering than the foregoing. The cuticular plates on the back are articulated together, and those on the under surface are more strongly developed than in skins from Mexico or the United States. They are of very little value for leather purposes, owing to the difficulty in properly tanning them.

Of the 280,000 skins used each year in the United States probably 56 per cent are furnished by Mexico and Central America, 22 per cent by Florida, 20 per cent by Louisiana, and the remaining 2 per cent by the other Gulf States. The South American hides do not come on the market in the United States.

The quantity of alligators has greatly decreased in all the Southern States, and it seems only a question of a few years when it will be impossible to obtain the hides at a price that will justify their general employment. Thousands of the animals have been slaughtered merely for sport, no use whatever being made of them. It is estimated that the number in Florida and Louisiana at present is less than 20 per cent of what it was twenty years ago. This decrease is attributed largely to the shooting of them in wanton sport. It has been deemed necessary to legislate for the protection of alligators in some localities, especially in Florida, owing to the rapid multiplication of the cane rat which threatened ruin to many harvests. There is a strong sentiment among the hunters in Florida and Louisiana favorable to a law interdicting the killing of those measuring less than 5 feet in length.

The hide should be removed shortly after the animal is dead, for in the warm climates putrefaction ensues quickly and the value of the hide is depreciated. The operation is begun by cutting through the scaly covering longitudinally from the nose to the end of the tail, along either side of the horny ridge along the back, or in the middle of the under surface of the animal. The former is the usual method in Florida and Louisiana, while the latter is common in Mexico and in Central America. Formerly it was considered difficult to tan the horn-like back properly, but it is now prepared almost as readily as the more pliable portions, and its use is very extensive.

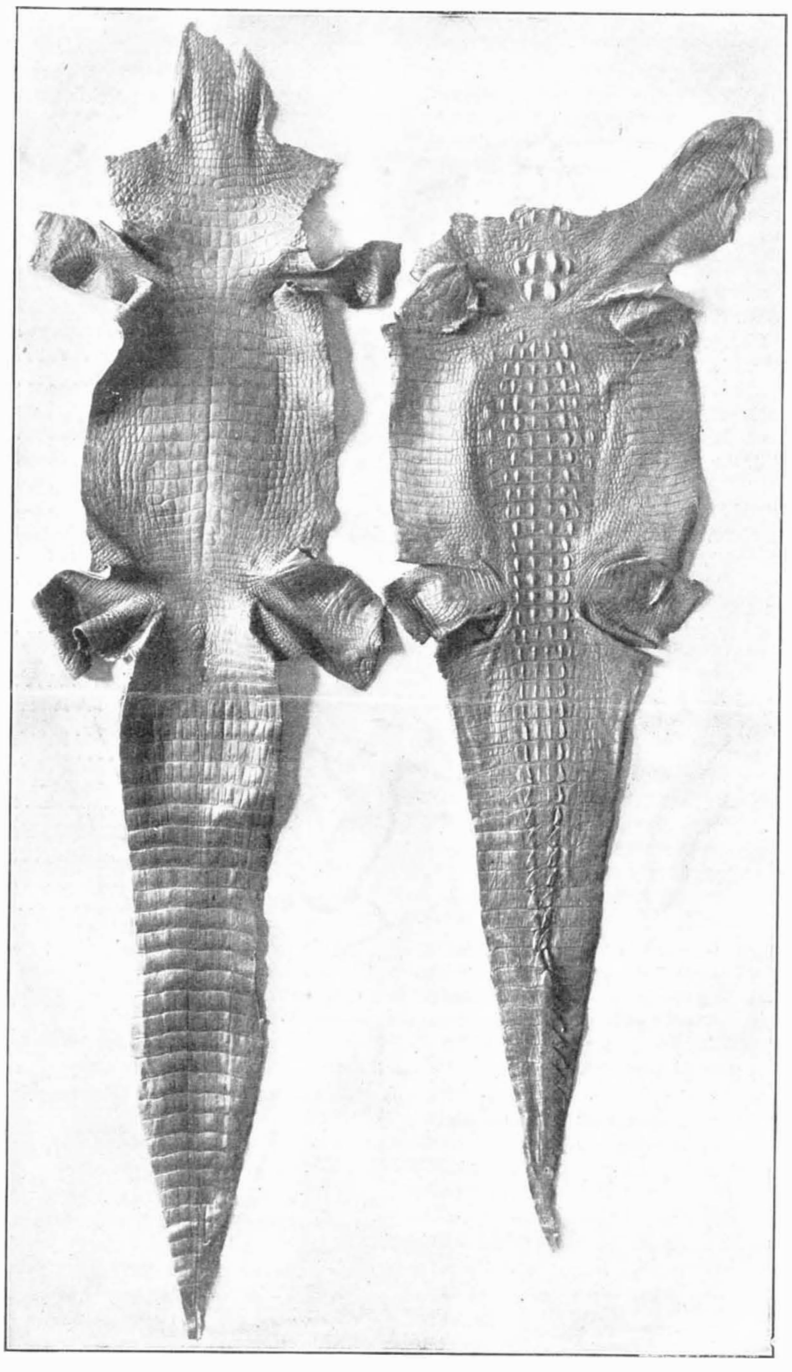
After making the incision above noted, a cut is made running from the longitudinal one to and along the middle of each of the legs on their upper side; or, if the back is to be saved, along the under side, extending almost to the wrists. After cutting around the jaws, the skin is peeled off in a blanket piece. Great care should be exercised to avoid careless cuts in the membrane. A very large percentage of the hides received in the market are badly damaged in this manner. These knife cuts may be scarcely noticeable in the raw skins, but when dressed are so apparent as to render quite valueless the part of the skin in which they are contained, resulting in much waste.

The hide should be salted immediately, the salt being carefully rubbed in all folds and crevices as well as over the entire inner surface of the skin, the use of coarse-grained salt being avoided. The edges along the abdomen and the parts from the legs are folded over neatly and the entire skin rolled up in a compact bundle and placed in a dry, cool place. Many hides spoil by reason of insufficient or indifferent salting, the grain side becoming so damaged that at best they are suitable only for second-class leather. After thorough curing, the salted hides are placed in boxes, barrels, or bags, and are bartered at the neighboring trading store, whence they are duly shipped to the tanneries.

The price received by the hunters for alligator hides varies from 15 cents to $2 each, according to the length and condition of the skin, and averages probably about 90 cents. Prime hides 5 feet long, with no cuts, scale slips, or other defects, are worth about 95 cents each, in trade, when the hunter sells them at the country stores, and about $1.10, cash, at the tanneries. Those measuring 7 feet are worth $1.55; 6 feet, $1.12; 4 feet, 52 cents, and 3 feet, 25 cents. Little demand exists for those under 3 feet in length.

TANNING ALLIGATOR HIDES.

The principal tanneries in the United States handling alligator hides are situated at Newark, N. J., and New York city, N. Y. Some hides are also prepared in New Orleans, Jacksonville, and in one or two of the tanneries in Massachusetts. Many are also exported to Germany and to England and there tanned. Alligator hides of all lengths, from 2 feet up, are used, but those most in demand are about 7 feet long. Hides over 10 feet in length are not much used, owing not only to their scarcity but to the hardness of the cuticular plates, making them difficult to tan properly and almost valueless for leather purposes, although some over 17 feet long have been prepared.



ALLIGATOR SKINS, UNDER-SURFACE AND HORN-BACK.

Formerly only the skin from the underpart and the sides of the animal was used, that from the back being so heavily armored with tough, horny plates and shields as to be of little value, except in case of very small hides. During recent years, however, a demand has existed for "horn" alligator, i. e., leather from the back of the animal, and this demand has been supplied by the importations from Mexico and Central America, a very large percentage of which are cut down the abdomen so as to preserve the back in one piece. The Louisiana and Florida skins are not cut "horn back" because they are not so flexible on the back as the Mexican.

On receipt at the tannery the hides are assorted according to their size, the small, medium, and large being treated separately on account of the difference in texture. With plenty of salt they are placed in a suitable storage room, whence they may be removed as required.

In the process of preparing for tanning, the skins are first immersed in vats of clear water, the smaller ones remaining about two days and the larger ones six days, according to the condition of the membrane. When sufficiently soaked they are immersed in a solu-

* Extracted from U. S. Fish Commission Report for 1902.

tion of lime, which should not be so strong as for depilating, and there they remain from eight to fifteen days, according to their size and the conditions of the water and the temperature. Each day the hides are reeled or removed into a stronger lime solution, great care being observed to avoid injuring the skin during this handling. The wet hides are now placed on a beam and shaved on the flesh side, all fat and superfluous flesh being removed. The bate of bran into which they next pass is made very weak, and in it the hides are gently agitated by means of a wheel, remaining there for ten to fifteen hours.

The hides are next cleaned in a wash-wheel tank and then immersed in a vat of oak bark extract, gambia, or sumac liquor of about 4 deg. strength. Every day or so the liquor is made stronger, increasing to about 20 deg. at the end of eighteen or twenty days. A gentle agitation of the tanning liquor during the last ten or twelve days is very beneficial, as it aids in the more thorough tanning of the skins and prevents the sediment of the liquor from settling in the creases, which is liable to rot the tender portions, especially in case of small hides. The hides are removed from the tanning liquor and suspended in the open air for samming, or partial drying and hardening, so that they may be again shaved on the flesh side to further reduce the thickness. They are returned to the tan liquor, where they are reeled for four or five days, the strength of the liquor being increased from time to time.

On removal from the tan liquor the second time, the hides are scoured with sumac water and selected for the different colors. Many are left in the natural color, yellowish brown. The popular dyed effects are black, and various shades of brown, green, yellow, red, etc. The coloring is done in a bath with wood and aniline dyes, the immersion lasting from ten to sixty minutes. The skins are next stretched out, and in most cases nailed on wide boards or frames for drying, and when thoroughly dry they are "staked" over iron beams or stakes for the purpose of making them flexible and pliable. If intended for shoes they are seasoned before staking, this consisting in stuffing them with tallow, fish oil, etc. But very few alligator hides are now prepared for shoe leather, since they are rather fancy for that purpose. After dressing them on the polishing machine, the skins are measured and stored in the warehouse or delivered to the leather manufacturers.

Although green alligator hides are sold according to length, tanned hides are sold by the width of the leather at the widest part. The price for skins of standard grade ranges from $1 to $1.65 per 12 inches of width. Some skins tanned and dyed in a superior manner sell for $2 or more for single skins 2½ feet in length. As a rule the Louisiana skins fetch the highest prices, and those from Florida the lowest.

Imitation alligator leather is now prepared in large quantities, principally from sheepskin or the buffing from cowhides. These are tanned according to the usual process, and before the skins are finished they are embossed with the characteristic alligator markings by passing them between two rollers.

VARNISHES.

WHAT VARNISHES ARE MADE OF.

VARNISH is a solution of resinous matter forming a clear, limpid fluid capable of hardening without losing its transparency. It is used to give a shining, transparent, hard, and preservative covering to the finished surface of woodwork, capable of resisting in a greater or less degree the influence of the air and moisture. This coating, when applied to metal or mineral surfaces, takes the name of lacquer, and must be prepared from resins at once more adhesive and tenacious than those entering into varnish.

The resins, commonly called gums, appropriate to varnish are of two kinds—the hard and the soft. The hard varieties are copal, amber, and the lac resins. The dry soft resins are juniper gum (commonly called sandarac), mastic and dammar. The elastic soft resins are benzoin, elemi, anime, and turpentine. The science of preparing varnish consists in combining these classes of resins in a suitable solvent, so that each conveys its good qualities and counteracts the bad ones of the others, and in giving the desired color to this solution without affecting the suspension of the resins, or detracting from the drying and hardening properties of the varnish.

"SPIRIT" VS. "OIL" VARNISHES.

In spirit varnish (that made with alcohol) the hard and the elastic gums must be mixed to insure tenderness and solidity, as the alcohol evaporates at once after applying, leaving the varnish wholly dependent on the gums for the tenacious and adhesive properties; and if the soft resins predominate, the varnish will remain "tacky" for a long time. Spirit varnish, however good and convenient to work with, must always be inferior to oil varnish, as the latter is at the same time more tender and more solid, for the oil in oxidizing and evaporating thickens and forms resin which continues its softening and binding presence, whereas in a spirit varnish the alcohol is promptly dissipated, and leaves the gums on the surface of the work in a more or less granular and brittle precipitate which chips readily and peels off.

Varnish must be tender and in a manner soft. It must yield to the movements of the wood in expanding or contracting with the heat or cold, and must not inclose the wood like a sheet of glass. This is why oil varnish is superior to spirit varnish. To obtain this suppleness the gums must be dissolved in some liquid not highly volatile like spirit, but one which mixes with them in substance permanently to counteract their extreme friability. Such solvents are the oils of lavender, spike, rosemary, and turpentine, combined with linseed oil. The vehicle in which the resins are dissolved must be and remain soft, so as to keep soft the resins which are of themselves naturally hard. Any varnish from which the solvent has completely dried out must of necessity become hard and glassy and chip off. But, on the other hand, if the varnish remains too soft and "tacky," it will "cake" in time and destroy the effect desired.

IMPORTANT CONSIDERATIONS.

Aside from this, close observers if not chemists will agree that for this work it is much more desirable to dissolve these resins in a liquid closely related to them in chemical composition, rather than in a liquid of no chemical relation and which no doubt changes certain properties of the resins, and cuts them into solution more sharply than does turpentine or linseed oil. It is a well known fact that each time glue is liquefied it loses some of its adhesive properties. On this same principle it is not desirable to dissolve varnish resins in a liquid very unlike them, nor in one in which they are quickly and highly soluble. Modern effort has been bent on inventing a cheap varnish, easily prepared, that will take the place of oil varnish, and the market is flooded with benzine, carbon bisulphide, and various ether products which are next to worthless where wearing and durable properties are desired.

FORMULAS.

With these remarks as a preliminary, below will be found some formulas and directions for making high-grade goods along successful lines.

1. *Spirit Varnishes.*

A Very Hard Varnish.

Gum lac	20 parts
Juniper gum	8 parts
Elemi	4 parts
Alcohol	100 parts

A Clear and Tender Varnish.

Juniper gum	1 part
Mastic	1 part
Balsam fir	2 parts
Alcohol	8 parts

A Good Wearing and Tender Varnish.

Juniper gum	20 parts
Mastic	10 parts
Elemi	4 parts
Alcohol	100 parts

Or,

Juniper gum	25 parts
Mastic	6 parts
Venetian turpentine	10 parts
Alcohol	100 parts

Watin's Spirit Varnish.

Juniper gum	125 parts
Gum lac in tears	62.5 parts
Mastic	62.5 parts
Elemi	31.25 parts
Venetian turpentine	62.5 parts
Alcohol	1000 parts

A Superior Tempered Spirit Varnish.

Juniper gum	80 parts
Mastic	100 parts
Elemi	30 parts
Concentrated essence of turpentine (turpentine evaporated to one-tenth its bulk)	60 parts
Castor oil	50 parts
Alcohol	1000 parts

For a thicker varnish increase the resins proportionately, but not the turpentine or the castor oil.

A Very Lasting, Golden-glittering Varnish.

Powdered benzoin	10 parts
Alcohol, enough to make	100 parts
Pure saffron, roughly broken up, about six threads to each ounce.	

Macerate three days and filter. Vary the quantity of saffron according to the shade desired. Mastic and juniper gum may be added to this varnish if a heavier body is desired. A variation of this formula will be:

Benzoin,
Juniper gum,
Gum mastic, equal parts.

Dissolve the gums in nine times their weight of alcohol (varied more or less according to the consistency wanted), and color to the desired shade with threads of pure saffron. This varnish is very brilliant and dries at once.

A Very Smooth Varnish.

Sandarac	100 parts
Mastic	50 parts
Venetian turpentine	20 parts
Elemi	5 parts
Castor oil	5 parts
Alcohol, 90 per cent	850 parts

Amber Colophony Varnish—Quick-drying.

Amber colophony	8 parts
Benzine (sp. gr. 0.71)	14 parts
Linseed oil varnish	3 parts
Gum turpentine	1 part

Melt the resins in the oil varnish, cool, add the benzine and mix well. This varnish wears well and resists moisture.

Spirit Picture Varnish.

Sandarac	24 parts
Mastic	8 parts
Copaiba	4 parts
Venetian turpentine	6 parts
Oil of turpentine	8 parts
Alcohol	80 parts

Mix, macerate 7 days and filter.

See that the picture to be varnished is perfectly clean and dry. Go over it twice with clear collodion, and let each coat dry thoroughly. Then apply one to three coats of the varnish, letting each coat dry thoroughly before putting more on. Apply only sufficient to get the effect desired. Oil colors must be quite dry before being varnished.

Aromatic Spirit Varnish.

(For Cabinets, Fan Boxes, Handkerchief Cases, etc.)

Strained styrax	dr. ij
Gum benzoin	oz. vj
Balsam Peru	dr. ij
Aloes	dr. iv
Myrrh	dr. iv
Balsam tolu	dr. ij
Po. ext. licorice	dr. ij
Gum olibanum	oz. j
Mastic	oz. iiij
Tr. cinnamon	oz. j
Alcohol	oz. 64

Mix; let stand 7 days; filter before using.

Colorless Varnishes.

(1) Sandarac	8 parts
Chloroform	1 part
Oil of lavender	6 parts
Alcohol	40 parts
(2) Dammar	2 parts
Acetone	9 parts
(3) White shellac	5 parts
Mastic	1 part
Oil of turpentine	1 part
Sandarac	5 parts
Alcohol	80 parts
(4) Orange shellac	2 parts
Alcohol	16 parts

Macerate these varnishes from 6 to 10 days. Then stir in two ounces to the pint of fresh bone-black, place on a water bath, and boil the whole for five minutes. Filter off a small portion and, if not colorless, stir in a fresh portion of bone-black and boil a few minutes longer. Finally strain through silk, or, better, filter.

This makes a clear, limpid, colorless varnish which may either be concentrated by evaporation, or diluted by the addition of spirits—or of more acetone in the case of formula Number 2. These varnishes may be tempered or made more elastic by the addition of cold pressed castor oil to the alcohol or acetone before being added to the resins. These varnishes are used to give luster and brilliancy to colors in oil, enamel paints, fine sign work, pictures, etc. White enamel paint covered with this varnish preserves its color indefinitely, and does not turn yellow.

COLORING "SPIRIT" VARNISHES.

The next step to be considered is the coloring of these varnishes, and in this work modern art in no way approaches the old school. For this purpose are used, separately and in blends, saffron (brilliant golden-yellow), dragon's-blood (deep reddish-brown), gamboge (bright yellow), Socotrine or Bombay aloes (liver brown), asphalt, ivory and bone-black (black), sandalwood, pterocarpus santalinus, the heart-wood (dark red), Indian sandalwood, pterocarpus indica, the heart-wood (orange-red), Brazil wood (dark yellow), myrrh (yellowish to reddish-brown; darkens on exposure), madder (reddish-brown), logwood (brown), red scammony resin (light red), turmeric (orange yellow), and many others according to the various shades desired.

In coloring spirit varnish the alcohol should always be colored first to the desired shade before mixing with the resin, except where ivory or bone-black is used. If the color is taken from a gum, due allowance for the same must be made in the resins of the varnish. For instance, in a varnish based on mastic 10 parts, and tender copal 5 parts, in 100 parts, if this is to be colored with, say, 8 parts of dragon's-blood (or any other color gum), the resins must be reduced to mastic 8 parts, and tender copal 4 parts. Eight parts of color gum are here equivalent to three parts of varnish resin. This holds true with gamboge, aloes, myrrh, and the other gum resins used for their color. This seeming disproportion is due to the inert matter and gum insoluble in alcohol, always present in these gum resins.

FACTS ABOUT "SPIRIT" VARNISHES.

Alcohol will hold in solution only about one-third of its weight in resins. Turpentine must be added always last to spirit varnish. Turpentine in its clear, recently distilled state will not mix with alcohol, but must first be oxidized by exposing it to the air in an uncorked bottle until a small quantity taken therefrom mixes perfectly with alcohol. This usually takes from a month to six weeks. Mastic must be added last of all to the ingredients of spirit varnish, as it is not wholly soluble in alcohol but entirely so in a solution of resins in alcohol. Spirit varnishes that prove too hard and brittle may be improved by the addition of either of the oils of turpentine, castor seed, lavender, rosemary, or spike, in the proportion required to bring the varnish to the proper temper.

SHELLAC VARNISH

is made in the general proportion of three pounds of shellac to a gallon of alcohol, the color, temper, etc., to be determined by the requirements of the purchaser, and the nature of the wood to which the varnish is to be applied. Shellac varnish is usually tempered with sandarac, elemi, dammar, and the oil of linseed, turpentine, spike, or rosemary.

2. *Oil Varnishes.*

Having seen in a general way how spirit varnish is compounded, the next group will include the more difficult oil varnishes. Old varnishers began by boiling their oils to an extent to render them siccative, and then after cooling, mixed in the resins in the form of

powders, having reheated the oil to a lesser degree; otherwise the high temperature necessary to boil the oil would burn and injure the delicate gums and resins used. This rational process has not been improved upon, and its importance is appreciated only when the manufacture of oil varnish is attempted without this preliminary. Oil varnish should be finally diluted with turpentine to the consistency appropriate to applying at least five or six coats. When conditions are suitable, experienced men favor ten to fifteen coats, each put on very thin and allowed to dry thoroughly before another is applied. In color varnish each succeeding coat should be a little darker than the preceding one. This is on the theory that the first coats, being lighter, will reflect light and brilliancy through the succeeding darker varnish.

A Well Tempered Varnish.

Dammar	2 parts
Plum tree gum	1 part
Venetian turpentine	1 part
Linseed oil	2 parts

Break up the resin and melt it. Dissolve the gum in the linseed oil and pour into the resin; then add the Venetian turpentine, place on a light fire and mix well. Finally, add spirits of turpentine to make of the right consistency.

A Quick-drying Varnish.

(1) Frankincense,
Juniper gum, equal parts.

Powder finely and dissolve in half their weight of Venetian turpentine over a slow fire. Finally add spirits of turpentine sufficient to give the desired body.

(2) Mastic	2 parts
Venetian turpentine	1 part

Powder the mastic, mix with the Venetian turpentine over a slow fire, and add spirits of turpentine in sufficient quantity.

The above three formulas make excellent picture varnish as well as varnish used for woodwork. Where a very heavy body is desired to finish with in one or two coats, the turpentine used is prepared as follows: Take 8 parts of oil of turpentine, boil on a slow fire until the residue equals one part, let this cool, and dissolve it in from one to three parts of warm oil of turpentine.

A Good Varnish for Dark Wood.

(1) Boil 12 parts of linseed oil until it scorches a feather; let cool, and add in powder form:

Juniper gum	2 parts
Aloes, hepatica	1 part

Heat gently until dissolved, dilute with turpentine oil as desired.

(2) Linseed oil	4 parts
Spirit of turpentine	2 parts
Aloes, hepatica,	
Juniper gum, of each	1 part

Proceed as in No. 1. No. 2 is more tender.

Oil Varnish that Wears Well.

(1) Mastic,	
Juniper gum, of each	2 parts
Linseed oil,	
Alcohol, of each	3 parts

Mix, and boil well over slow fire. Add spirits of turpentine in sufficient quantity.

(2) Linseed oil	1 part
Gum dammar	3 drachms

Boil together in a closed vessel and add spirits of turpentine in sufficient quantity.

(3) Linseed oil	32 parts
Dammar	4 parts
Pine resin	1 part

Proceed as in No. 1.

(4) Juniper gum	1 part
Turpentine gum	2 parts
Oil of turpentine	4 parts

Proceed as in No. 1.

(5) Mastic,	
Juniper gum, of each	4 parts
Gum turpentine	1 part
Oil of lavender	4 parts
Linseed oil	8 parts

Proceed as in No. 1.

A very transparent varnish is made by mixing six parts each of balsam of fir and oil of turpentine with one part dammar.

Amber and hard copal varnishes are very beautiful and lasting when well made by fusing the gums (which requires special appliances, high temperature, and great precaution) and then combining them with turpentine and linseed oil, which must be added hot, in the quantities necessary to get the body and temper desired.

Japan Varnish.

Oil of turpentine	90 parts
Oil of lavender	120 parts

Mix and completely dehydrate by digestion with calcium chloride. To the product add:

Camphor	1 part
Tender copal	90 parts

Put the vessel on hot ashes or on a slow sand bath and shake frequently until the copal is dissolved. Set aside 24 hours and filter.

Genuine Japan varnish is said to be the product of a tree indigenous to Japan. It is obtained from exudation and by extraction from the wood, and gives a coating much harder than the best copal varnish, without brittleness. It takes a high polish which lasts centuries, and is proof against water, alcohol, and almost every substance known.

COLORING "OIL" VARNISH.

A most difficult problem now presents itself in giving to oil varnish a desired and permanent color. Only a very few appropriate color bodies are directly soluble in oil, and therefore much manipulation is necessary to impart desirable colors to oil varnish without detracting from its transparency. It is almost impossible to lay on evenly a varnish in which a substance is held imperfectly in solution. Probably the only exception to this rule is pure ivory or bone black, a very light homogeneous and finely divided powder which is often used to make varnish a dead black. But the best varnishers object even to this, preferring to use first a black finely ground in oil and finish with a clear, colorless varnish, where a brilliant black surface is desired.

The first principle of varnish making is to have always a perfect solution, either filtered or decanted from the insoluble matter that may appear after the mixture is completed. Color must therefore be added to varnish without affecting its brilliancy or the perfect solution of its component parts.

Oil has the peculiar property of holding in solution many substances not directly soluble in the oil, but which may be dissolved in a volatile liquid that also dissolves the oil, and after mixing the two and driving off by evaporation the common solvent, the body indissoluble in the oil itself is found in perfect solution therein. This principle affords the only possibility of imparting certain colors to oil varnish.

The following general formula will show

THE METHOD OF PROCEDURE IN COLORING OIL VARNISHES.

Take of

Sandalwood, or any desired color wood yielding its color to alcohol, in fine powder	100 parts
Or,	
Of dragon's-blood, gamboge, myrrh, or any color gum	80 parts
Alcohol	1000 parts

Mix and macerate in the sun or in a warm place for 10 days, shaking the bottle frequently. Filter through cloth and add to the filtrate:

Of the same color wood	100 parts
Or of the same color gum	80 parts

Macerate 10 days as above, shake often, and filter through paper. Take a portion of the filtrate and evaporate to two-thirds of its bulk. This will then have the color of the finished varnish. By experimentation and careful memoranda determine the exact shade of color desired, and color the entire filtrate accordingly. To lighten the color use gamboge dissolved in alcohol. To darken it use a solution of dragon's-blood or asphalt. Now reduce the alcohol, properly colored, on a water-bath to one-half its bulk; add 667 parts of oxidized turpentine, and volatilize the alcohol at a temperature above the boiling point of alcohol and below that of turpentine, after which remains 667 parts of colored turpentine. This is the colored essence of oil varnish. After the alcohol is dissipated, raise the temperature slightly for a few minutes to drive off the water that may have been in the alcohol. The red shades of color in turpentine may be lightened by the addition of a solution of gamboge in turpentine prepared as above, or darkened with a solution of dragon's-blood or sandalwood in alcohol, and the alcohol driven off as described. But to lighten turpentine colored with sandalwood a solution of gamboge in alcohol must be used, and the alcohol driven off, for a solution of gamboge in turpentine precipitates sandalwood in turpentine. An alcoholic solution of sandalwood oxidizes with age and darkens in color, but this is not true of a solution of sandalwood in turpentine. It must also be remembered that all colors are more or less changed by contact with alkali. The above additions to lighten or darken the color must not be used in sufficient quantity to change in a great degree the composition of the varnish.

Now to finish this varnish take

Mastic	10 parts
Tender copal	5 parts
Turpentine colored as above	100 parts

Mix, and finally add:

Raw linseed oil (as old as possible)	5 parts

Mix thoroughly by placing the mastic in a vessel, add the turpentine, and agitate occasionally until dissolved. This takes from 24 to 36 hours. When quite dissolved add the copal, which will dissolve in the same length of time. Mix in the linseed oil, let stand 10 days and filter. When the turpentine is colored with dragon's-blood or a color gum, reduce the mastic to 8 parts, and the tender copal to 4 parts.

This is the highest grade of oil varnish and is intended to be laid on in from 8 to 12 or 14 coats. However, if after a few coats are laid on the color is deep enough, you may finish with one coat of mastic, 20 parts; tender copal, 10 parts; colored turpentine, 100 parts; linseed oil, 12 parts. Mix as above.

It is almost impossible to get pure raw linseed oil in the market, and it is desirable to obtain this by exhausting ground linseed with carbon disulphide and recover the same, which leaves a pure oil of the highest quality for varnish purposes.

MANUFACTURING HINTS.

Glass, coarsely powdered, is often added to varnish when mixed in large quantities for the purpose of cutting the resins and preventing them from adhering to the bottom and sides of the container. When possible, varnish should always be compounded without the use of heat, as this carbonizes and otherwise changes the constituents, and, besides, danger always ensues from the highly inflammable nature of the material employed. However, when heat is necessary, a water bath should always be used; the varnish should never fill the vessel over a half to three-fourths of its capacity.

THE GUMS USED IN MAKING VARNISH.

Juniper gum or true sandarac comes in long, yellowish, dusty tears, and requires a high temperature for its manipulation in oil. The oil must be so hot as to scorch a feather dipped into it, before this gum is added; otherwise the gum is burnt. Because of this, juniper gum is usually displaced in oil varnish by gum dammar. Both of these gums, by their dryness, counteract the elasticity of oil as well as of other gums. The usual sandarac of commerce is a brittle, yellow, transparent resin from Africa, more soluble in turpentine than in alcohol. Its excess renders varnish hard and brittle. Commercial sandarac is also often a mixture of the African resin with dammar or hard Indian copal, the place of the African resin being sometimes taken by true juniper gum. This mixture is the pounce of the shops, and is almost insoluble in alcohol or turpentine. Dammar also largely takes the place of tender copal, gum anime, white amber, white incense, and white resin. The latter three names are also often applied to a mixture of oil and Grecian wax, sometimes used in varnish. When gum dammar is used as the main resin in a varnish, it should be first fused and brought to a boiling point, but not thawed. This eliminates the property that renders dammar varnish soft and "tacky" if not treated as above.

Venetian turpentine has a tendency to render varnish "tacky" and must be skillfully counteracted if this effect is to be avoided. Benzoin in varnish exposed to any degree of dampness has a tendency to swell, and must in such cases be avoided. Elemi, a fragrant resin from Egypt, in time grows hard and brittle, and is not so soluble in alcohol as anime, which is highly esteemed for its more tender qualities. Copal is a name given rather indiscriminately to various gums and resins. The East Indian or African is the tender copal, and is softer and more transparent than the other varieties; when pure it is freely soluble in oil of turpentine or rosemary. Hard copal comes in its best form from Mexico and is not readily soluble in oil unless first fused. The brilliant, deep-red color of old varnish is said to be based on dragon's-blood, but not the kind that comes in sticks, cones, etc. (which is always adulterated), but the clear, pure tear, deeper in color than a carbuncle, and as crystal fiery as a ruby. This is seldom seen in the market, as is also the tear of gamboge, which, mixed with the tear of dragon's-blood, is said to be the basis of the brilliant orange and gold varnish of the ancients.

A FINAL WORD.

It is to be hoped that with a little effort, and these few suggestions, naturally abbreviated for lack of space, the druggist of to-day may be able to get in touch with the craftsmen in the varnish trade. When the high price of the varnish on the market is compared with the cost of the products outlined above, it is no surprise that so many mushroom concerns so soon grow to opulence in this business. A hint to the wise druggist is sufficient. The time and labor spent in getting this trade under your roof will never be regretted.—Bulletin of Pharmacy.

SOLDERING FOR ALUMINIUM AND ITS ALLOYS.

A SOLDER, said to be effective, consists of a soldering salt which may be used either alone or in combination with a metal, or rather with a metallic solder, whose fusing point is less than that of its alloys.

This soldering salt is a mixture of sodium chloride, zinc chloride and cadmium chloride, which are roasted or melted and ground to a fine powder after being cooled. This powder may be employed alone. It is placed on the surfaces to be soldered, and the operation may be conducted with the blow-pipe as usual. But in many cases it is necessary to employ a metallic solder at the same time.

The metallic solders are formed by metallic alloys whose fusing point is lower, as said above, than that of aluminium and its alloys. Such an alloy or solder may be obtained from aluminium, tin, zinc, cadmium and lead, which are mixed in suitable proportions, melted and cast in small pieces for the solder. The suitable proportions for the mixture are the following: 1 part of aluminium, 5 parts of tin, 5 parts of zinc, 5 parts of cadmium and ½ part of lead. In place of aluminium, alloys of this metal may be employed, such as the alloy of nickel and aluminium or of magnalium.

By varying the proportions in the composition of metallic solders, a color may be given to the aluminium or its alloys, which will render the solder almost imperceptible. But in composing the metallic solders there must not be too much aluminium or its alloys, such as the alloy of nickel aluminium or magnalium, which would not render the solder sufficiently fluid.

The solders are preferably employed by mixing the ground metallic solder with the soldering salt in suitable proportions, placing the mixture on the surfaces to be soldered, and using the flame of the blow-pipe.

The places united with these solders are clean, and the solder is permanent.

To avoid the disaggregation of the solders, feared so much in the case of aluminium, and which occurs after a time, the solders obtained in the way described are submitted to ulterior treatment in aqueous solution of sodium hyposulphite, exposing the soldering or the objects soldered for an hour or more, to the action of this solution.—Translated from La Revue des Produits Chimiques.

In London a chemist has a small tube of radium bromide which he hires to physicians at so much per hour. As the Pharmaceutical Journal says that there is in the whole of the world's largest city considerably less than a single grain of the marvelous chemical, the beauty of this plan is at once manifest. Two

shillings sixpence (62 cents) is suggested as a reasonable charge for an hour's use of the tube, and 87 cents for an application by the chemist himself.

A POMPEIAN HOUSE AND ITS UTENSILS.

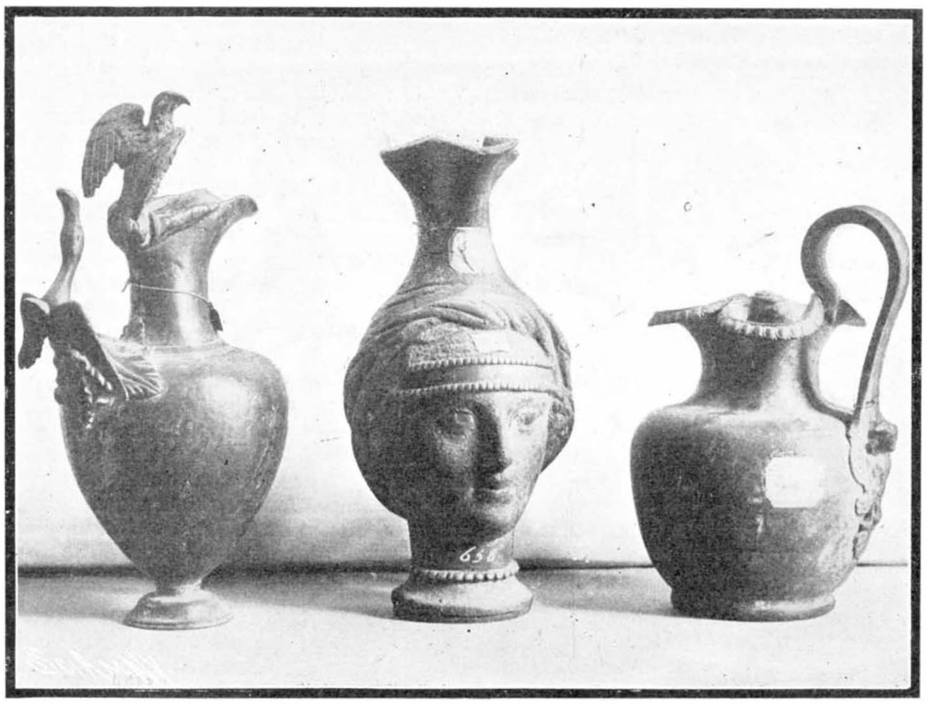
By the Paris Correspondent of the Scientific American.

The House of the Vetii, as it is called, is the most recent to be discovered at Pompeii, and at the same time the most remarkable. It is laid out and ornamented in the best of taste, and contains some of the finest paintings and wall decorations which have yet been found. Owing to the great value of the paintings and the other objects, it was decided not to attempt their removal to the Museum, as has generally been done, but to restore the house as nearly as possible to its original form, and make it a specimen of the Roman dwelling house. Accordingly, it has been roofed over, and special guardians appointed to look after it.

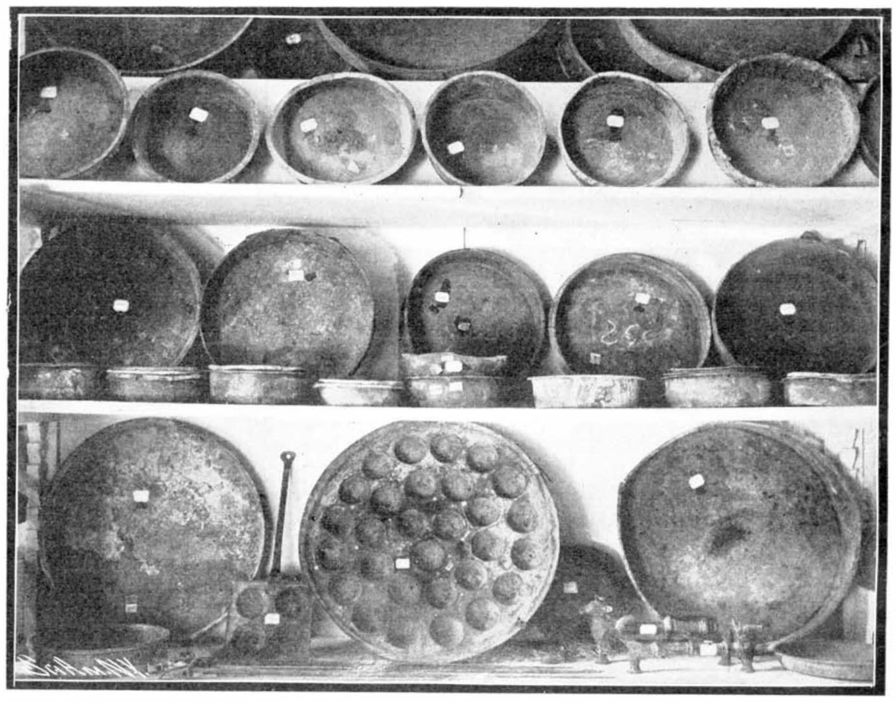
On entering the gateway we pass through a vestibule into a court, which is decorated with frescoes. On either side the visitor's attention is attracted by a large and heavy coffer or strong box, which no doubt played the part of the modern safe, and contained the treasure of the proprietor. There seems to be no doubt that he succeeded in escaping when Pompeii was buried, and then came back and dug into the house, taking away most of the valuables; for the strong boxes were found open and empty, and most of the portable objects were removed from the house. A number of rooms, handsomely decorated with paintings, open into the court. However, it is the peristyle, or second court lying back of the former, which attracts the most attention. The garden, which has been arranged as nearly as possible after the original plan, is surrounded by a colonnade. The roof is upheld by a series of graceful columns. In the foreground and rear are two rectangular marble basins, into which a stream of water flowed from a group on either side. The groups in the foreground are of bronze, and each represents a boy holding a goose. On the other side the groups are of marble. The garden has several other basins and fountains. On different sides of the colonnade are three marble tables placed between the columns. They no doubt served for taking refreshment at different hours of the day. The tables are placed so that one of them will always be in the shade. No doubt the members of the family passed most of their time in the colonnade around the garden, and could change their position according to the direction of the sun.

Opening into the court is a room which is especially worthy of attention, as it contains the finest paintings which have been found in Pompeii. The general tone of the room is a dark red, and each of the four sides originally contained a large painting. The fourth was removed, either at the time when the house was ransacked by the owner, or at a previous period. The three paintings which remain represent classical subjects—Apollo and the Python, Iphigenia in Tauris, and the Sacrilege of Agamemnon. These three paintings are of a high order, and were no doubt executed by Greek artists after well-known originals. The decorative borders contain a series of boys or cupids in different occupations and are quite remarkable in design, and a series representing winged girls making garlands of flowers.

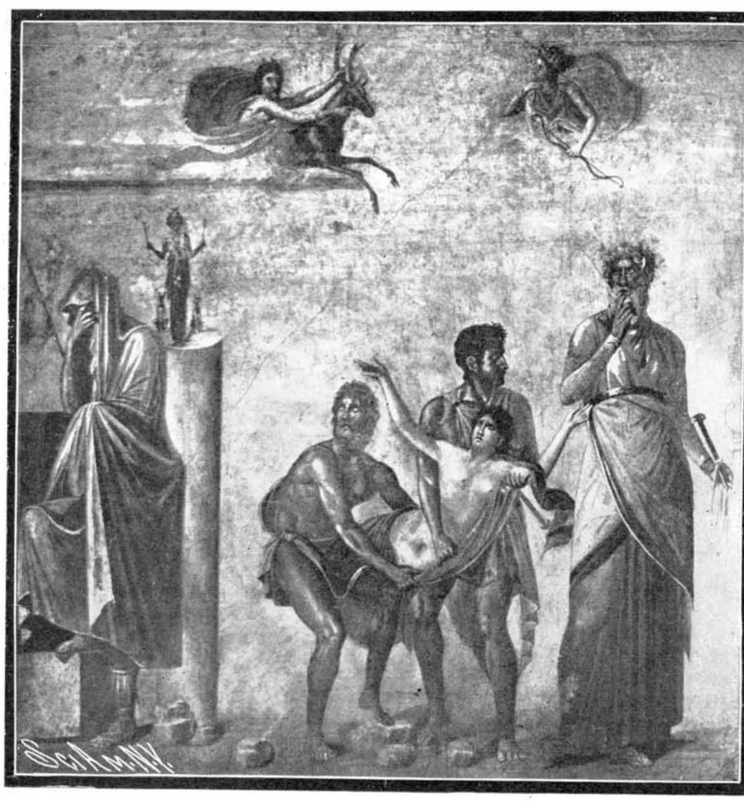
In this connection it will no doubt be of interest to add a reproduction of a large wall-painting which formed part of the decoration of another house and has now been removed to the Naples Museum. It is selected as one of the few which will bear photographing, as in general the fresco tones are too flat to give a good impression. The painting represents the Sacrifice of Iphigenia. Some of the kitchen utensils are shown in another illustration. In the lower row will be noticed a large pan containing a number of circular depressions, and was no doubt used for cooking eggs. A similar utensil containing four depressions and provided with a long handle lies beside it. In front are a number of long spits for roasting meat, with ornamental heads, while on the right is a pair of andirons of curious form. Different bronze vases or water pitchers are shown in another engraving. The vase on the left has the mouth surmounted by an eagle, while the handle has the form of a swan. In the handsome specimen in the middle, the body is represented by the head of a woman. The diadem, eyes, and necklace are of silver inlaid in the bronze.



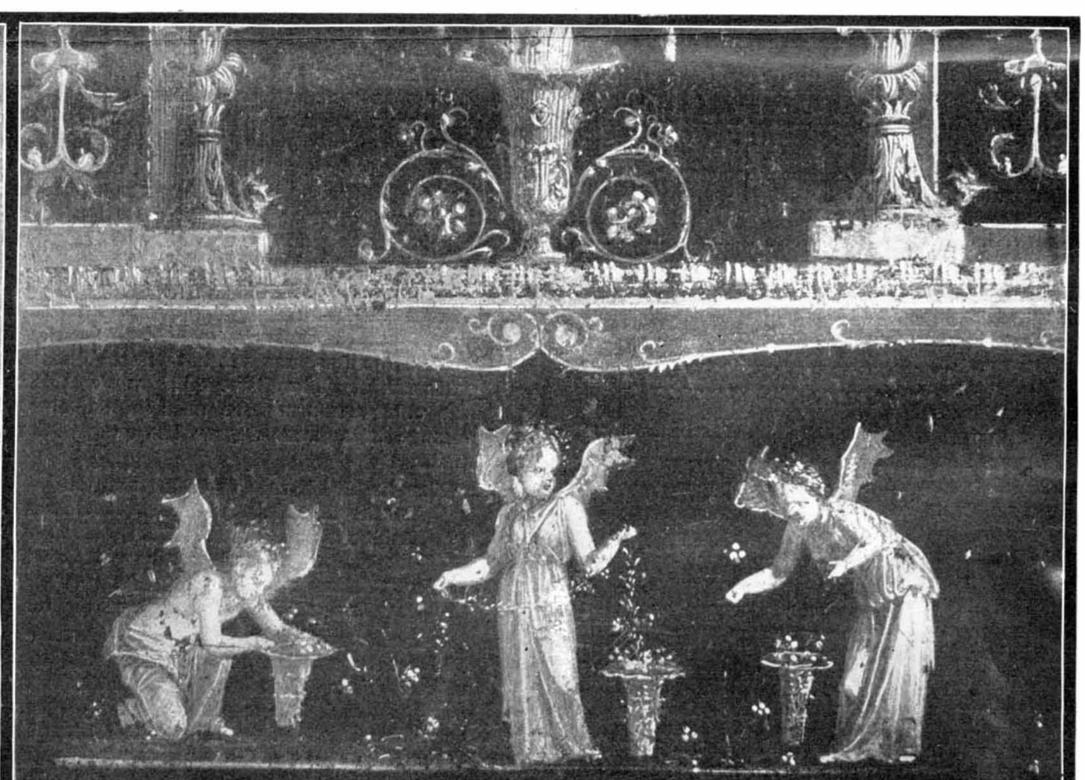
BRONZE PITCHERS FROM POMPEII.



POMPEIAN KITCHEN UTENSILS.



A MURAL PAINTING IN A HOUSE AT POMPEII.



PAINTED WALL BORDER OF A HOUSE IN POMPEII.

FIRE PROTECTION FOR STEAM VESSELS AND GOVERNMENT REGULATIONS.

By J. H. Morrison.

In the early days of steam navigation in this country, the small number of fires on steam vessels, exclusive of those created by the explosion of the boilers, were caused by the ignition of the woodwork around the boiler, or of the wood intended for fuel in the boiler being placed too near the furnace door. Cases have been known where the wood was found in a blaze, caused by the sparks from the furnace flying out in the hold, and setting the cord wood on fire. During this period, the owners of steam vessels equipped their vessels with such appliances for fighting fire as seemed to them most effectual. There was no law at the time to govern their action in that regard.

Congress had the question of the safety of steam vessels in the United States before them in 1837, mainly regarding the explosion of steam boilers, and an act was passed in 1838 containing a provision for equipping all passenger steam vessels at sea or on the northern lakes with "three longboats or yawls, each of which shall be competent to carry at least twenty persons; . . . and further to provide as a part of the necessary furniture, a suction hose and fire engine, and hose suitable to be worked on said boat in case of fire." There does not appear to have been any provision in this law for equipping the river steamboats as provided for those named. It was only after the "Lexington" was burned on Long Island Sound in January, 1840, that Congress made any move to inquire more fully

into the subject, and even then there appears to have been no law passed sustaining the recommendations of the committee. In the report of the committee there is found among the recommendations for the prevention of fires: "The most obvious of those means are, making the boiler rooms fireproof by a lining throughout of sheet iron, and an under lining of sheet lead in the wake of the boiler; protecting the decks around the smoke pipes in a similar manner, and employing constantly a faithful fire watch, especially in the night time. To these means of prevention, add the means of promptly extinguishing incipient fires, such as fire engines, buckets with baling ropes, and reservoirs of water on the decks; and as a last resort, let there be boats enough to save passengers and crew." It would seem from all the information we have on the subject at the present day, that Congress did not think at this period that our river steamboats required so complete an equipment for fire purposes as that named in the law of 1838. Probably it was thought they could be beached most readily in case of a great emergency. There were passenger boats on the rivers along the Atlantic coast equipped with fire-engines and buckets as required under the law of 1838, for in the examination for the cause of the loss of the "Lexington," Capt. Manchester, the pilot, said in part: "I called to those on the forecastle to get out the fire engine and buckets. The engine they succeeded in getting out, but I did not see any of the buckets, except two or three which we found afterward on the forecastle."

There was no material change in the fire equipment of our steamboats until about 1850, when the independent steam pump invented by H. R. Worthington, a few years before, was brought into use for pumping up the boiler, as well as fitted for fire purposes. All this preceded the new steamboat law of 1852, that was then in course of preparation. It was originally taken in hand by Congress through the loss of the steamboat "G. B. Griffith" on Lake Erie in 1850, where there was a large loss of life. This law required, among other provisions, that no license should be granted, "or, if any combustible material liable to take fire from heated iron, or any other heat generated on board such vessels in and about the boilers, pipes, or machinery, shall be placed at less than 18 inches from such heated metal or other substance likely to cause ignition, unless a column of air or water intervenes between such heated surface and any wood or other combustible material so exposed; and further, when wood is so exposed to ignition, as an additional preventive, it shall be shielded by some incombustible material in such manner as to leave the air to circulate freely between such material and the wood." The purpose of this provision is readily seen to have been to prevent the ignition of the woodwork around the boilers, for most of the fires on steamboats up to that time had started in that locality of the vessel. The wooden deck beams and stanchions were located close to the boiler, and without any protection from the heat of the latter, and the steam chimney casing had but little air space from the heated iron. Covering the boiler with hair felt, to prevent radiation of the heat, was a measure adopted to economize in the consumption of fuel in the boiler, and it also prevented the hazard to the woodwork in the immediate vicinity of the boiler that before existed. This was first used on our coastwise steamships after the experiment demonstrated its usefulness about 1855, but was not used on our river boats for some years after. About 1875 iron deck beams were used over the boilers of some of our wooden-hull boats to lessen the risk of fire.

The local inspectors under the law of 1852 evidently had, at an early day, their own trials in their endeavors to carry out some of the requirements of the law, and the inefficient condition of the fire pumps and fittings for immediate use in case of an emergency on some of the vessels, called forth a strongly-worded order that the entire equipment must be kept in condition for immediate use. In the Annual Report of 1857 the inspector said: "Such resolutions have been passed at former sessions with respect to keeping fire pumps, hose, etc., in order and ready for use; but subsequent experience has shown that such has not been the effect; and we have therefore passed a resolution that fire hose must be kept constantly attached to the pump, ready for immediate use. The necessity for this has been shown in some cases where the short delay of getting the hose to its place and attached, has been of sufficient duration to permit the fire to attain such headway that all after efforts to control and extinguish it were fruitless." This they followed up year after year.

The use of a non-inflammable coating or fire-proof paint for application to the light woodwork of steamers received the early attention of the Board of Supervising Inspectors, but nothing further than a solution of lime, glue, alum or salt was suggested. The subject was taken up at a later date, and silicate of soda was experimented with and found to answer a useful purpose.

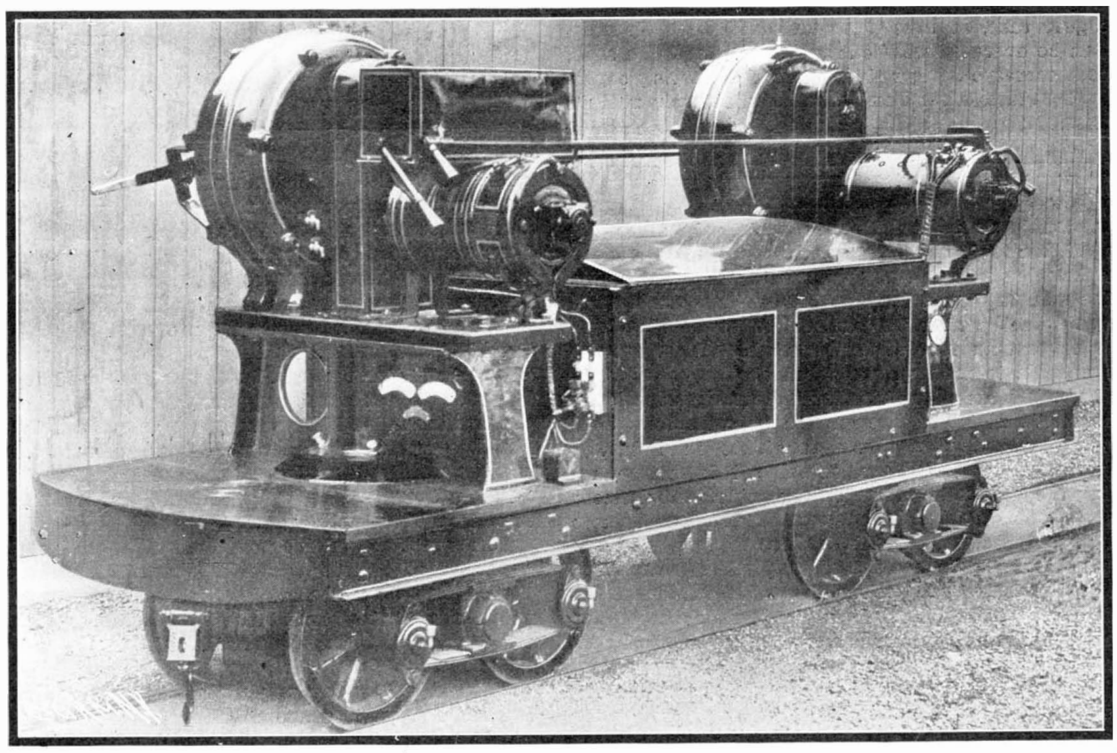
There is one thing that should be prohibited on all passenger steamboats, and it is on many of them, and that is smoking by the deck crew. This practice, if permitted at all, should be restricted to some room *on deck*, that has been set aside for that purpose.

One of the best examples of a strict compliance with the law, in being prepared for an emergency by fire, came under my notice about twenty years ago on the "Kaaterskill," of the Catskill line, then a new boat. My curiosity was excited by noticing a line of hose stretched on the main deck; and believing such things were not laid there under normal conditions, I looked around to find the purpose of its being there, and found the hose attached to the pump in the midship deck house, and run to the forward gangway, with the nozzle pipe hanging overboard, and the pump working so that a stream of water was passing through the hose overboard ready to be taken up at a moment's notice, pump opened full, and there was a stream of water at once for use, without any delay in taking down a length of hose, starting a pump, etc. No doubt there are other lines which have the same system in operation when the vessels are running.

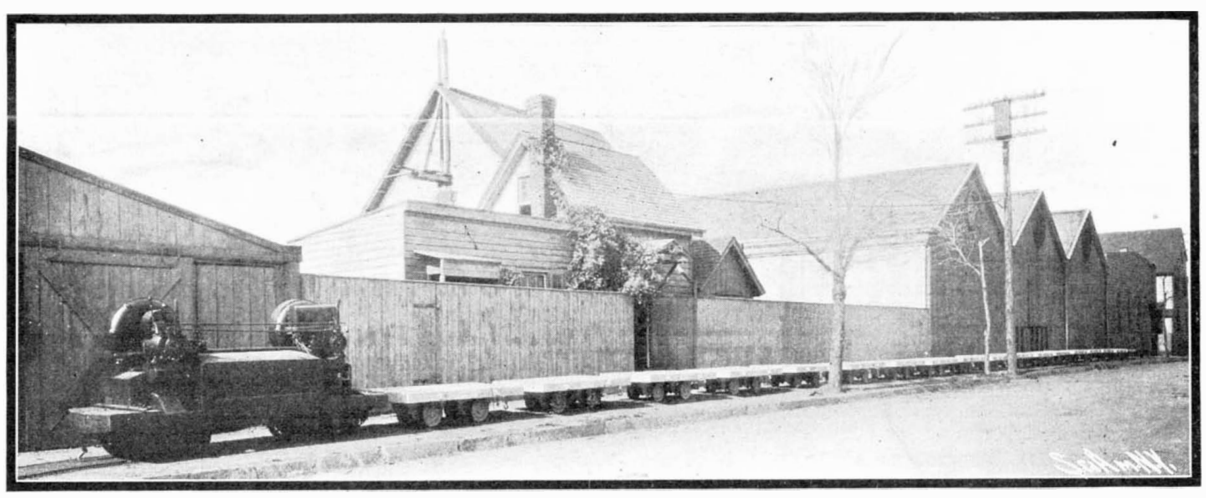
STORAGE BATTERY LOCOMOTIVES FOR SHOP TRANSPORTATION.

By J. A. MCINTYRE.

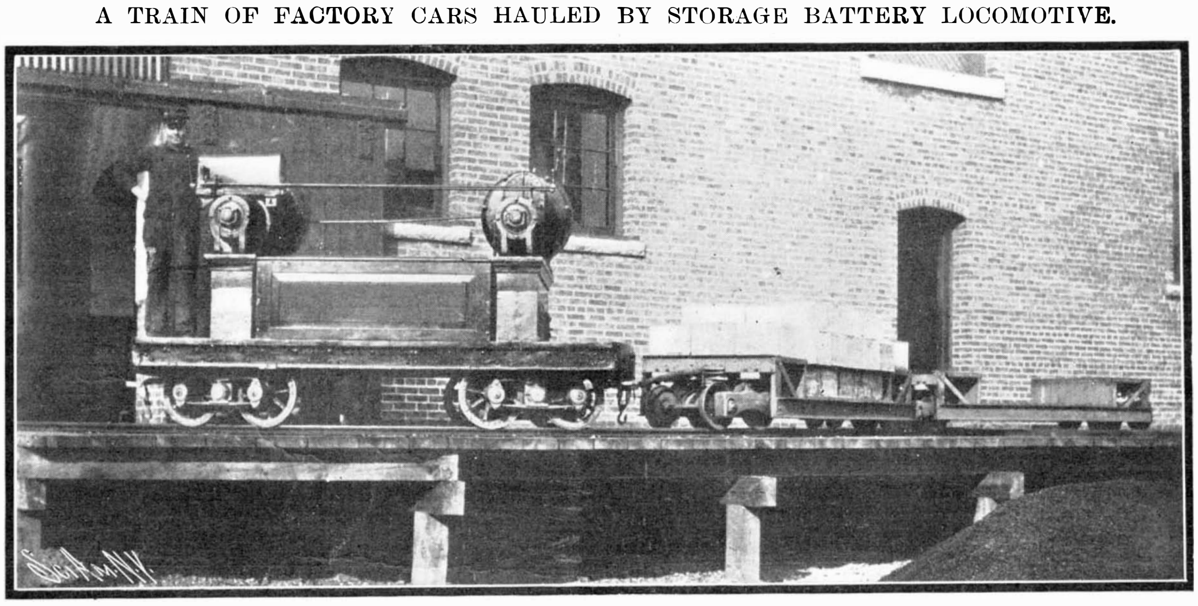
A MOST interesting exhibit may be seen at the Louisiana Purchase Exposition, which consists of an electric circuit battery locomotive, forming part of the exhibit of C. W. Hunt & Co., of New York. The exhibit is instructive in so far as it shows modern tendencies in shop transportation, and incidentally the remarkable development which the industrial electrical locomotive has witnessed within recent years.



THE HUNT STORAGE BATTERY LOCOMOTIVE.



A TRAIN OF FACTORY CARS HAULED BY STORAGE BATTERY LOCOMOTIVE.



THE STORAGE BATTERY LOCOMOTIVE USED IN A BRICK PLANT.

One of our illustrations shows an electric locomotive used at a bolt works. The locomotive is of novel design, and was specially built for the work to be done. The bolts and nuts are loaded into baskets containing about 250 pounds each, and each car carries twenty baskets, that is, twelve in the sunk portion and four on each of the upper ends. The machines which manufacture the nuts and bolts deliver their product a short distance above the floor level. For this reason the car is built low, so that the baskets can be drawn directly from their supports upon the car without lifting.

An electric locomotive has also been in use in a lead plant at Federal, Ill., for handling the slag cars, and also for moving the ladle car which distributes the molten metal in various parts of the foundry. Such a system is much safer than overhead cranes or trolleys, because the spilling of the metal is prevented. The storage battery locomotive may here and there be found in foundries for handling castings and pig iron.

Two narrow-gage electric locomotives may be seen at the East Pittsburg works of the Westinghouse Company. The railway upon which the locomotive in question is used connects the various bays, departments, yards, and buildings, and brings all pieces of heavy work within range of the cranes and hoists. Part of the system runs within the broad-gage tracks, switches and crossings being made without cutting the standard rails.

The entire absence of fire risks makes the storage battery locomotive a valuable and safe method of handling inflammable and explosive materials. It is, therefore, not astonishing that these locomotives are now being introduced into textile mills, where their economy, their cheapness, and their safety are brought into evidence more and more. One of these textile locomotives is used for delivering carloads of baled cotton in eleven New England mills, covering considerable area. A steam or trolley-electric locomotive was out of the question, on account of the great danger of fire. Before the storage battery locomotive was adapt-

ed for transporting the raw material to the textile mill, the cars had been moved one at a time by three horses harnessed in tandem. The storerooms were so constructed that the horses would have no means of exit in driving in ahead of the car, for which reason it had to be sent in under its own momentum. Starting some distance back, speed was gotten up, and, at the psychological moment, the "tag-holder" unhooked the "tag" fastened to the traces in the front of the car. The method is obviously dangerous. Sometimes with a heavily-loaded car the horses were unable to give it the necessary momentum, and the services of a loading gang had to be requisitioned. This is all done away with now; one man is all that is needed. In light switching service, the batteries can be recharged at various times during the day, while the locomotive is waiting between hauls. For heavier service it can be recharged during the noon hour or after working hours in the evening. Each motor has a separate gear case, so that in an emergency the locomotive can be operated with one motor. This, to be sure, means a corresponding reduction in the hauling capacity; but on the other hand, the locomotive is still in commission.

THE SENSITIVENESS OF CHEMICAL REACTIONS.

By Dr. L. Brandt.

Chemical science, existing as such only since the close of the eighteenth century, has to-day a deep influence upon almost every domain of human activity. On the one hand, its laws and teachings are turned to benefit in the chemical branch, to produce by synthesis a great number of products which have become indispensable to modern man; but on the other hand, they have become of constantly increasing importance to the world at large through the opposite analytical process. Chemical analysis furnishes in industry, commerce, and agriculture valuable information regarding the character of the most varying substances; in the hygienic field it has proven of great usefulness for the common weal in the testing of food products for purity; and in the service of justice it often renders possible the unraveling of intricate criminal cases. In the following lines I will try to present to the reader a general picture of the sensitiveness peculiar to chemical reactions, and at the same time of the accuracy which the analytical chemist may attain in his work.

Indispensable for the very exact analyses is a very delicate balance, which as a rule will still respond in the case of a weighting of 100 grammes to as small a quantity as 1/10 milligramme, that is, to the millionth part of the weighting. For physical and especially for particularly exact chemical investigations still finer scales are used, which are sensitive even to 1-100 or 1-200 milligramme.

For the mere detection of a body without ascertaining its weight, frequently considerably smaller quantities are required than can be determined on the most accurate scales.

Among the most sensitive material actions which we know are those which many substances exert upon our organs of sense, especially the sense of smell. A piece of musk will send its emanations into the remotest corners of a large room, betraying its presence to every one who may enter; yet it would be impossible for a chemist to detect the substance in the air of the room in any other way. The extremely unpleasant odor of mercaptan, an organic sulphur compound, is, according to reliable tests, perceptible to the sense of smell in the quantity of one four-hundred-and-sixty-millionth of a milligramme (1-460,000,000 milligramme) in one cubic centimeter of air; this is a sensitiveness not attained by the most delicate reactions of spectral analysis. In spite of these astonishing performances, it is well known that our sense of smell is not to be compared with that of many animals, the dog, for example. It is difficult to conceive that actually material particles, emanating from the fleeing game, come into action in the nose of the dog when he is following a track several hours old; or that they excite the wild animal's olfactory nerves when he scents the hunter from afar. Yet there are indubitable traces of such material particles, which produce these effects, and are obedient to the law of gravity, though we must give up even a rough estimate of their weight.

The sense of taste also shows a high degree of sensitiveness, though far below that of smell. About 4-5 milligramme of cane sugar, placed upon the tongue in a solid state, is perceptible to the taste; of saccharine, which is 550 times sweeter, about 1½-1,000 of a milligramme would be sufficient. The extremely bitter taste of strychnine and of picric acid has not quite this intensity, since with strychnine 1-200 milligramme of the nitric salt is required, and with picric acid 1-500 milligramme of the substance.

The actual chemical methods also, which are employed for the detection of separate substances, do not all show the same sensitiveness. We will first consider those which are founded upon the insolubility or the difficult solubility of a compound. Very many substances which are soluble in water or other liquids can be converted by the addition of fixed reagents into insoluble compounds, which are then separated as precipitates. The more difficult of solution the resulting compound is, the weaker can be the solution used for precipitation, and consequently the greater is the sensitiveness of the reaction. Among the compounds most difficult of solution are sulphate of barium, one part of which requires more than 400,000 parts of water for solution, and chloride of silver, which requires about 1,000,000 parts of water, by weight. The latter substance results when a solution of common salt is brought together with a solution of silver; in strong solutions there is formed a white precipitate, of the appearance of fresh cheese, in very dilute solutions only a milky cloudiness. By this reaction the salt can be detected when dissolved in 2,000,000 volumes of water, that is, ½ milligramme in a liter, or ½ gramme in a cubic meter. If 10 cubic centimeters are employed for the test, the quantity which will produce reaction is about 1-200 milligramme.

I wish to mention here a reaction distinguished by great sensitiveness, which from its nature can be compared to the formation of precipitates; namely, the formation of arsenic mirrors through decomposition of arsenide of hydrogen. Here is a matter of the separation of a solid substance, not from a liquid, but from a gas, a phenomenon which is exactly analogous to the formation of precipitates in liquids. To test a substance for arsenic, it is placed in a dissolved state in a gas-generating apparatus, in which hydrogen gas is produced, whereupon the arsenic present escapes, mixed with quantities of free hydrogen, as the extremely poisonous arsenide of hydrogen. On heating the current of gas in a suitable tube, the arsenide is decomposed, and the arsenic is separated as a dark, mirror-like film upon the heated portion of the tube. By this method 1-100 milligramme—according to some authorities 1-1,000 milligramme—of arsenious acid can be detected with certainty. It is even not easy to procure reagents which after this test are found entirely free from arsenic. The greatest care is therefore necessary, particularly in investigations for courts of justice, lest arsenic be discovered, originating not in the object under examination, but in the reagents.

Of late the method of Gutzeit is frequently preferred, in which the arsenide of hydrogen, produced as before, is made to act upon paper soaked in a solution of silver nitrate, and the presence of arsenic detected by the appearance of a brown color. This test is still more sensitive than the other, and it is asserted that 1-10,000, even 1-20,000, milligramme can be detected by it in its improved form.

The reactions which are made known by the appearance of colorings are in general more sensitive than those characterized by the formation of precipitates, since many substances possess an astonishing coloring power. It is a familiar fact even to the unscientific that a little crystal of permanganate of potassium will color a glass of water intensely red. If the solution is so much diluted that the color becomes pale, though still distinct, it will contain about 1-5 milligramme to a liter. Iron can be detected in about the same dilution of 1 to 5,000,000 through the formation of the deep-red rhodanide of iron; since only about 10 cubic centimeters are necessary for the reaction, the actual amount of iron which can be detected is about 1-500 milligramme.

We find even more intense coloring power in the organic dye-stuffs, as will be shown by some examples. One milligramme of phenolphthalein is sufficient in alkaline solution to give a reddish color to 30 liters of water; while one milligramme of fuchsine is perceptible in 50 liters of water, thus diluted in the proportion of 1 to 50,000,000. Among the numerous organic dyestuffs, fluoresceine, whose sodium salt has the commercial name of uranine, is also worthy of mention from the fact that its alkaline solutions possess the quality of fluorescence, that is, they show different colors in light falling through them than in light simply falling upon them. This quality, also observable in ordinary petroleum, is splendidly exhibited in uranine solutions, so that this dyestuff almost equals fuchsine in intensity. Since uranine is besides this very permanent, it has been used to trace the course of streams underground, and in numerous cases has been the means of discovering the subterranean connection of watercourses with each other or with their source.

An extraordinary sensitiveness is shown by some reactions used in detecting nitric or nitrous acid, and therefore important in the examination of drinking water. Nitric acid is detected by letting the water fall in drops into a sulphuric solution of diphenylamine, whereby a deep-blue ring forms around the water drops. According to Lunge, this reaction is perceptible when only 1-20 milligramme of nitrogen to the liter, thus 50 milligrammes to a cubic meter of water is present in the form of nitric acid. Since only ½ cubic centimeter of water is used in this test, the real acting quantity of nitrogen is only 1-40,000 milligramme—certainly an astonishing sensitiveness.

For the detection of sulphurous acid there are a number of reagents, the most sensitive of which is the one suggested by Griess, sulfanilic acid in combination with sulphate of alphanaphthylamine; this will detect with certainty 10 milligrammes of nitrous anhydride in a cubic meter of water. Thus 1-100 gramme of the substance diffused in 10 hectoliters or 2,000 pounds of water can be detected by this reagent—one part by weight to 100,000,000 parts of water.

Having observed the greatest dilutions in which substances can be discovered by the most delicate chemical reactions, it will perhaps be interesting to compare these with dilutions which the homeopathists have occasionally employed in their medicines. The tinctures which were the starting point were diluted according to the decimal or the centesimal scale, that is, to tenfold or hundredfold volumes. A part of the "first potency" thus obtained was again diluted ten to a hundredfold; and this process was often repeated as far as the thirtieth potency or beyond. With a saturated solution of salt, containing about 26 per cent of salt, there would result at the sixth potency of the decimal scale a solution so dilute that no salt could be detected in it by silver nitrate. The greatest dilution in which the extraordinarily delicate reaction of nitrous acid with Griess's reagent takes place (1 to 100,000,000), would be about equal to the eighth potency. The thirtieth potency corresponds to a dilution of about one part to a quintillion, a number expressed by 1 with thirty ciphers. In the centesimal scale the thirtieth potency contains one part to a decillion (1 with 60 ciphers). The days, however, when the homeopathists considered such exaggerations a proof of their skill, and vied with each other in greater and greater dilutions of their medicines, are now past; later homeopathy has learned moderation in this point.

Chemical science has not for all substances such delicate reactions as the above described. But in cases where a sufficiently sensitive reaction is lacking, very slight traces of dissolved substances can be discovered through concentration of the solution by evaporation. An example of this is the discovery of gold and silver in the water of the ocean. It has been proved that a cubic meter of salt water contains 6-100 gramme of gold and nearly as much silver, so that one gramme of gold is contained in 17 cubic meters of water. In spite of this small percentage of 0.000006, the gold dissolved in the sea water of the whole globe would reach the amount of 73 milliard (thousand million) tons; since the total amount of the waters of all the oceans is estimated at twelve hundred million cubic meters, this gold, if in one solid bar, would fill a space of four cubic kilometers, or four milliard cubic meters. To obtain this treasure would certainly be difficult, in view of the extreme dilution; yet in the last few years processes for this purpose have been repeatedly patented, without, however, any practical results having been heard of.

Almost all the above-mentioned reactions are surpassed in sensitiveness by a method which has, to be sure, only a limited use, but exhibits a positively phenomenal sensitiveness; namely, spectral analysis. A knowledge of its nature must be taken for granted here, and I shall only give a few examples of its action.

The detection of common salt is possible with the aid of the sodium line when only a three-millionth part of a milligramme is employed. In the spectroscope there is always a pale sodium line, because the air always contains traces of salt, which is drawn up in evaporation from the flood of salt water covering the greater part of the earth's surface, and carried by the winds all over the continents. In order to bring out the sodium line in perfect distinctness, it is only necessary to raise a little dust near the spectral apparatus. The sodium reaction is, to be sure, equaled in delicacy by no other reaction of spectral analysis; of lithium carbonate 1-100,000 milligramme is the smallest discoverable quantity, of potassium salts 1-1,000 milligramme.

Spectral analysis is practicable for the examination of liquids if the latter, in vessels with even parallel walls, are placed between a source of light and the spectroscope. It is frequently made use of in this way to distinguish between different dyestuffs, and can serve, for example, to detect artificial coloring matter in red wines. Blood in very minute quantities can be discovered spectroscopically; and carbonic-oxide poisoning can be detected with great certainty in dead bodies by a spectroscopic examination of the blood, since the coloring matter of the blood, containing carbonic oxide, behaves in a very characteristic manner. Blood is also used, therefore, for detection of minute quantities of carbonic-oxide gas in the air. A portion is shaken with water and a few drops of blood, and the liquid tested by the spectroscope. In this way one part, by weight, of carbonic oxide to 1,000,000 parts of air can be detected.

After considering so many reactions of remarkable delicacy, at the command of analytical chemistry, it is the more surprising to hear of the late discovery of many widely-diffused substances, which have until the very latest times escaped observation. Argon is to be mentioned in the very first instance, a gas which constitutes almost one per cent of the atmospheric air, but whose existence has only been known for a few years. In this case the great similarity of this gas to nitrogen, and its extremely slow chemical action, explain the striking fact. Several other elements have been lately discovered in the air—crypton, xenon, and neon; which, however, are present in extremely slight traces, and therefore were not discovered until we learned how to liquefy air in considerable quantities, and to bring about through partial evaporation a concentration of the rare elements. The amount of crypton in the air, for example, is about 1-50,000 per cent.

I will point out in closing a few technical achievements which deserve notice on account of the great dilution of the substances to be obtained. A material must be very valuable to make its extraction profitable in such a case; we find our examples therefore among the precious metals. The metallurgist separates silver from lead when it amounts to only 1-10,000 of the latter. One part of gold can be profitably extracted from 2,000 parts of silver. According to the newer method of extracting gold from auriferous sand, this is worked for as little as 2.3 grammes of gold per ton, or 0.00023 per cent. These are noticeable achievements, which in part surpass the accuracy of many analytical operations. That they are exceptional, and to be carried out only under especially favorable conditions, is easily understood when we remember that in technical operations the expense of the process must be considered, a fact which as a rule soon sets a limit to the admissible dilution of the substance to be obtained.—Translated for the Scientific American Supplement from Prometheus.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

American Products in Central France.—Limoges Industrial Exposition.—The industrial conditions in central France are very promising. Much encouragement and impetus have been given to trade by a regional exposition held in Limoges from May 1 to November 1, 1903. Attention was called to this exposition in a previous report sent from this office.*

A large number of manufacturers from Germany, Belgium, Great Britain, and a very few from the United States exhibited their goods with satisfactory results. German lithographic machinery was extensively advertised and the exhibitors succeeded in interesting many of the buyers of such goods in this section.

It is very unfortunate that the display of American agricultural machinery and implements was so small and so unattractively placed in this great center of agriculture. The mowers and reapers exhibited were considered in every respect superior to others and were awarded the first prizes.

The demand for traction engines was surprisingly large, only those of French manufacture being exhibited. The sale of such machines is constantly increasing.

A large number of all kinds of vehicles was sold, such as wagons, carriages, carts, etc.

American vs. French Vehicles.—The fault found with American vehicles is that they are too light. As a rule the wheels are not solid enough and the tires too narrow for service in this country, as it is customary in France to load wagons much more heavily than in the United States, the roads being smoother and better. Every vehicle, even of the lightest kind, is supplied with a brake. American manufacturers have too often omitted this important and necessary article on all kinds of wagons, carriages, etc., when sending them to France or even exhibiting them in France. The comparative cost between French and American carriages of the same class is about one-half in favor of the American. There is certainly an opportunity for opening a good trade in American-made vehicles in France.

Spokes, Hubs, and Fellies.—At present the demand for spokes, hubs, fellies, etc., is large. Hickory spokes are preferred for cabs and ordinary carriages, and oak spokes for large, heavy drays and wagons. If American representatives of these goods solicited orders in France, their sale could be increased considerably.

Staves.—Staves and handles are always in demand. There has been a change made lately, to a limited extent, in the transportation of wines, alcohols, and other liquids. Instead of putting them in the ordinary sized barrels of 200 to 300 liters (52.85 to 79.25 gallons) they are shipped in huge tuns containing from 10,000 to 20,000 liters (2,642 to 5,284 gallons). This method of shipping reduces the cost of transportation and creates a demand for especial kinds of staves, the usual dimensions of which are: Length of staves and diameter of tun, 2 meters (78.7 inches); contents, largest tun, 20,000 liters (5,284 gallons); medium tun, 15,000 liters (3,962 gallons); smallest tun, 13,000 liters (3,434 gallons).

Some of these tuns (foudres) are made of enameled iron, placed on stationary platform cars and transported from one place to another without being removed; their dimensions are approximately the same as those given above.

The figures given of the importation of staves into France for 1901 are 121,000 metric tons, of which over 90,000 tons came from Austria-Hungary and 21,000 tons from the United States.

It is further stated that the supply of Austro-Hungarian wood is declining and becoming difficult of access; therefore the price of this commodity will increase.

The stave business deserves especial attention on the part of the American producer, as it promises a fine field for future development.

American Shoes and Shoe Machinery.—The United States still leads in the manufacture of shoes and shoe machinery. The best leather, machinery, threads, and all other furnishings for shoe making are imported from the United States.

It is surprising to notice the gradual change that is taking place in shoe shapes. The striking peculiarities that characterized French shoes ten years ago are rapidly disappearing and American shapes are now found everywhere. The model lasts are imported in large quantities from Massachusetts and are extensively copied throughout France.

The largest shoe factory in France uses only American machinery. The growth of this manufactory is phenomenal. Before the Paris exposition of 1900 this factory was a very small one, employing only French machinery. Since then it has increased until it is now the largest in the republic.

The American shoe machinery exhibited at the 1900 exposition at Paris was bought in block by this firm and to-day its annual sales run up into the millions of francs. Two enormous new buildings have been erected within two years and more than 1,000 hands are constantly employed. This manufacturer imports the following articles direct from the United States annually: Kid and other leather, $62,918; shoe findings, etc., $1,737; stains, cements, inks, etc., $1,967; and pays a monthly royalty on machines of $3,185. If these figures be multiplied by three it will give the approximate amount of shoe fixings imported into this city (Limoges) by the shoe manufacturers yearly—say, about $209,424. This is a good illustration of what may be done by intelligent representation of American machinery and goods.

American manufacturers should remember that conservative people, no matter how inferior their methods may be, must be carefully taught how to employ new inventions, which must be shown to them before they will purchase.

There are six large factories making shoes in Limoges that now use American machinery, and many other like factories are being started in other parts of France, to be furnished with American machinery also.

Agricultural Machines and Implements.—The difficulty farmers have in obtaining hand labor and the tendency of the laborers to drift toward industrial centers increase the demand for labor-saving machinery. Other countries may endeavor to snatch this important trade in agricultural machinery and implements from American manufacturers, but they can only do so when and where Americans are unwilling to study the peculiar conditions and requirements of the French farmers. Little details and peculiarities that may often seem useless and trifling to American manufacturers are, on the other hand, just the requirements necessary for successful sales.

The foreign competitor succeeds because he satisfies the buyer, often giving him an inferior article, but letting him have his own way in these small matters. The manufacturer from the United States may be conscious of the superiority of his merchandise and still fail to sell because he lacks adaptability. Sometimes a little paint and more care in polishing journals are considered; then, again, the machine may not cut at the required height, etc. These adaptations can be easily made, and the market may be won thereby.

American Horses for the French Cavalry.—Numerous inquiries have been made at this office by Americans concerning the demand for horses from the United States and several horse dealers have requested information on this subject.

Limoges is the headquarters of the Twelfth Army Corps, and the horses of the light and heavy cavalry need renewing constantly, as the life of an army horse is only five years of active service.

A number of American horses have been introduced into France for cavalry service; some have not given satisfaction because they were pressed into service before they had become acclimated. It usually takes a foreign horse the best part of a year in France to get into good condition, especially if he comes from the western plains without being trained.

This business could be greatly developed by intelligent and painstaking efforts. The particular requirements of the French market should be followed, such as the height, weight, etc. French horse breeders are exporting many horses to Russia for her army, and horses are consumed as food in all European countries. This branch of the trade is very remunerative all over this republic.

Fruit—Canned and Dried Fruits.—Foreign canned and dried fruits were scarcely known in France a few years ago; to-day there is hardly a grocery of any importance in any French town but has American dried fruits on its shelves.

Already complaints are heard in France about the inroads made on the home trade by these foreign fruits, but careful investigation shows that the sales of French goods are practically the same as they were before the advent of the Americans in this market. French taste is changing; far more people use dried and canned fruits now than ten years ago. The prices of these so-called luxuries have been so greatly reduced as to bring them within reach of classes that could not enjoy them before the introduction of the foreign products.

Fresh Fruits.—The French markets are beginning to abound in fruits that formerly were unseen, or very rarely seen. Bananas and pineapples are no rarity now; nearly every fruit store sells them. Bananas shipped from the West Indies are on sale in Paris and other large cities. The time is not far distant when the fresh fruits of Florida and California will be as common in French cities as they are now in New York.—Walter T. Griffin, Commercial Agent at Limoges, France.

American Manufactures in the Netherlands.—In his annual report for the year 1903, United States Consul-General S. Listoe, of Rotterdam, under date of November 25, 1903, transmits the following statements (1) from Messrs. Wynmalen & Hausman and (2) Messrs. A. van der Laan & Co., the first importers of machinery and tools and the second general importers of American manufactures:

Messrs. Wynmalen & Hausman to Consul-General Listoe.

"The demand for American machinery and tools is not as good as might be expected. Certainly a large quantity of small and cheap tools—like files, screwing tackle, etc.—is sold here, but the bulk is imported from Germany. The German article is far inferior, but so cheap that even its inferiority seems no disadvantage to the buyer. Prices seem to be considered first, then quality.

"The prospects for the sale of American machinery are not bright at present. The market is flooded with cheap machinery from all the manufacturing European countries, and this cheap machinery has the preference. The Dutch manufacturers, with few exceptions, are small people, who do not produce specialties, but an all-round line of goods. They cannot, therefore, purchase tools prepared for one purpose only, but must get the machinery that will accomplish a lot of different work. Most American machinery is made to do one kind of work, and but few machine manufacturers in the United States can fill the needs of the Dutch market."

Messrs. A. van der Laan & Co. to Consul-General Listoe.

"As far as our lines (graphophones, gas stoves, coal stoves, scales, rubber gas tubes, lamps, refrigerators, mangles, oak-wood mantels, lawn mowers, plows, cameras, pressed glassware, tin kettles, washing machines, wringers, bicycles, etc.) are concerned, trade with the United States has been pretty fair. The only trouble this year has been that American manufacturers have been utterly unable to take care of their foreign orders. The rush in the home market seems to have been very heavy and nearly all factories have been so overcrowded with work that deliveries have been exceedingly slow, especially of iron and wooden articles. Delays of from four to six months have been very common, and this has of course influenced the trade unfavorably. The sharp advance in the prices of raw material, especially those of wood and iron, and the difficulties which American manufacturers have in obtaining same in sufficient quantities have also caused a general rise in prices, which we are afraid will cause a decrease in the imports of many articles, which under the present circumstances can be bought cheaper on this side of the ocean. There is practically no limit to the nature of articles that might be imported from the United States; it is merely a question of prices and quick deliveries.

"New articles from the United States have been exceedingly scarce of late. We, ourselves, are constantly on the lookout for same. Specialties in the iron and wood trade still remain the best for introduction into our market."

Importers of American carpet sweepers, ranges, boilers, radiators, plumbers' articles, and general hardware claim that the trade in these lines, notwithstanding the heavy European competition in some of them, is very good.

Hungary's Ministry of Commerce.—The administration and organization of the Royal Hungarian Ministry of Commerce in the capital and residence city of Budapest have just been reformed and simplified by the new minister, Charles Hieronymi. At present there are only 7 instead of 16 special sections (bureaus) and 21 instead of 33 subsections. It is hoped that prompter and more creditable dispatch of business will ensue.

The new divisions comprise:

I. Presidential section.

II. Roads and bridges section, under which are: (1) County and town roads and bridges, (2) state roads, (3) Croatian matters, (4) mechanical road and bridge matters, and (5) high buildings.

III. Marine and navigation section.

IV. Railroad (administrative and mechanical section: (1) General railroad administration and building, (2) local, small, and city railroads, (3) railroad and navigation tariffs, and (4) railroad mechanical matters.

V. Railroad business and traffic section.

VI. Foreign commerce section.

VII. Post, telegraph, and telephone section: (1) Moneys, (2) personnel, (3) international matters, (4) bookkeeping and tariffs, (5) telegraph business and administration, (6) mechanical matters, and (7) postal routes and economics.

VIII. Industrial and commercial section: (1) Industrial administration, (2) industrial and commercial education, (3) industrial development, (4) labor protection, and (5) internal commerce.

The bureau of industrial education and the bureau of labor inspection have been created as distinct executive offices subordinate to, but not included in, the organization of the ministry.—Frank Dyer Chester, Consul at Budapest, Hungary.

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No. 1991. June 29.—Canadian Railway and Mining Notes—New Stone Viaduct at Plauen—Conditions in the Philippines during 1903—Cattle and Horse Diseases in South Africa—Trade of Foreign Countries and the United States for January, 1904—Waterworks and Sewers for Monterey, Mexico—Steel Shipbuilding in Canada—Consumption of Salt in Austria.

No. 1992. June 30.—Political and Commercial Progress of Mexico—The North German Lloyd Balance Sheet for 1903—Discrimination Against American Manufacturers—Indurated Fiber Ware Wanted in France—Telephone and Tramway Openings in Spain.

No. 1993. July 1.—* Our Small South American Trade—Cocoanut, Palm and Rapeseed Oil in the Netherlands—British Columbia Steamship Service—Mineral Production of Canada in 1903—American Cereal Foods in Austria—Commercial Education in Bosnia—Tuberculosis in Belgium—Railways in Africa—Turkish Customs Inspection of Importations—The Commercial Use of Consular Reports—Consular Reports and Foreign Journals—School for Cab Drivers.

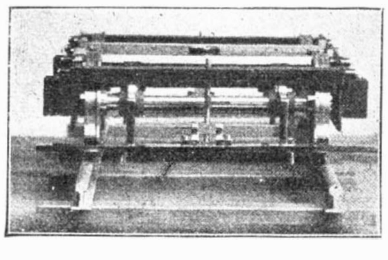
No. 1994. July 2.—* Our Trade Opportunities in Cyprus—Railway Construction in Korea—California (?) Prunes from France—New Radium Finds and Cures—* Hints for Leather Exporters—Foreign Trade of Russia in 1903—Exports of Argentina for the First Three Months of 1904—Copper Production of the World—Shipping through the Suez Canal—More Hygienic Measures for London—Navigation of the Upper Rhine—Norwegian Cod Fisheries for 1904—Export Trade as an Economical Factor—* Foreign Companies in Venezuela—Human and Animal Tuberculosis Alike—* German vs. American Tool Machinery—* Counterfeiting American Products—Milking Cows by Electricity—Somnoform, a New Anæsthetic—Italy's Citrous Fruits—Alcohol from Peat—European Freight Rates to Argentina—The German Steel Trust—Silk Cocoons in Servia.

Other Reports can be obtained by applying to the Department of Commerce and Labor, Washington, D. C.

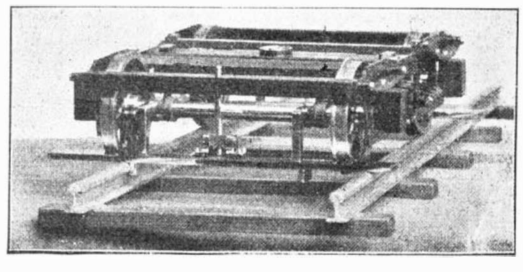
* Printed in Advance Sheets No. 1639 (April 24, 1903).

AN APPARATUS INTENDED TO LESSEN DAMAGE IN DERAILMENT.

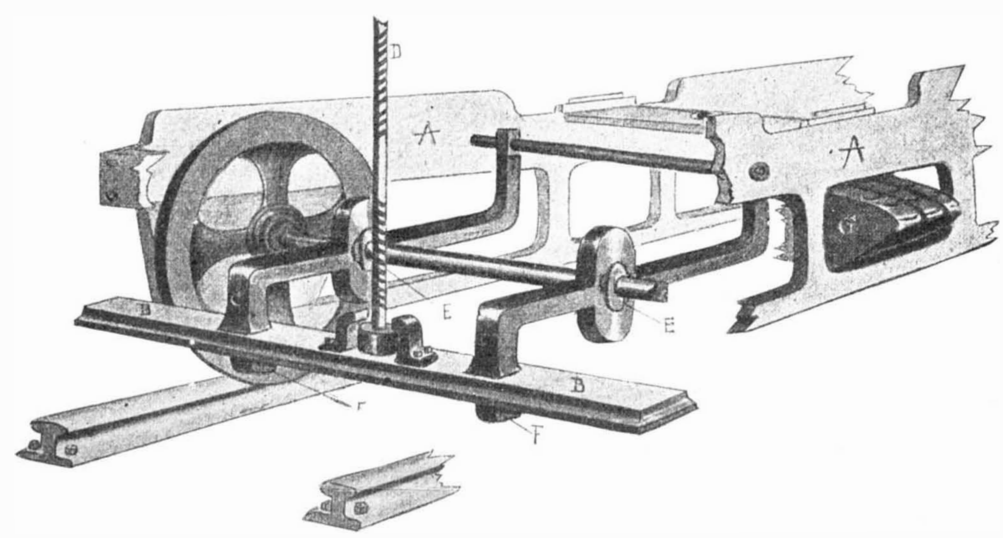
HERR GEHRICKE, a railway official, has obtained a German patent for a safety truck which, it is claimed, will minimize damage from derailments, whether these are caused by defective rails or by the breaking of wheels or axles. In case of derailment, the car is supported by transverse bars in front of and behind the truck, which bars slide on the rails and by their braking action gradually bring the train to a standstill. To diminish the shock, these bars are placed as near the rails as possible, and the shock is further taken up by springs, on which the whole weight of the car rests. These springs are placed in the center of the truck, and connected with the bars by bent levers. The axles pass through eyes in these levers, which hold them in place in case of breakage of axle or wheel. As the springs give according to the load, the cross-bars may be raised or lowered by screws worked from inside the car. In freight cars the adjustment is made from outside. The cross-bars are considerably longer than the width of the track, and are provided with internal flanges as a guard against a second derailment.



SAFETY TRUCK WITH WHEELS ON RAILS.



SAFETY TRUCK DERAILED.



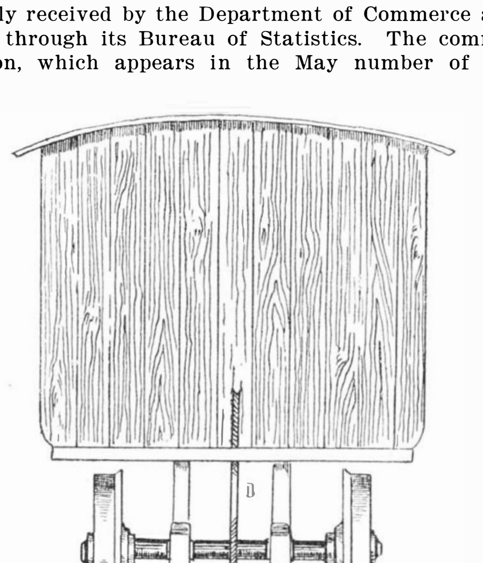
LOWER PART OF TRUCK, WITH FRAME PARTLY REMOVED TO SHOW SAFETY DEVICE.

A. Frame. B. Cross-bar. C. Lever. D. Adjusting screw. E, F. Cross-bar flanges. G. Spring (shown in part).

The accompanying illustrations explain, better than any verbal description, the working of the device.

THE WAR AND JAPAN'S COMMERCE.

AN interesting picture of conditions in Japan is afforded by a communication from the Japanese manager of the Eikoku Shogyo Zasshi, published at Tokio, recently received by the Department of Commerce and Labor through its Bureau of Statistics. The communication, which appears in the May number of the British Trade Journal, indicates that commercial and financial conditions have not as yet been seriously affected by the Russo-Japanese war, and this statement is verified, so far as relates to commerce with the United States, by the official figures showing the trade of the United States with Japan during the present year as compared with earlier periods.



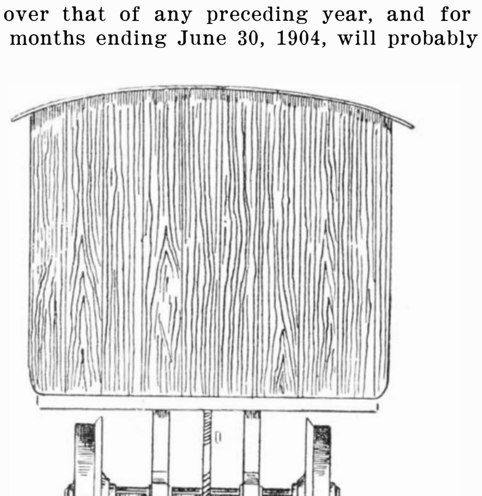
CAR ON RAILS.

A. Cross-bar. B. Lever. C. Cross-bar flange. D. Adjusting screw.

Commenting upon trade and financial conditions in the Japanese Empire, the writer above referred to says:

"When the Russo-Japanese negotiations were broken off and the hostilities were opened between these two powers, we feared that a great panic would occur in our economic world and our commerce and industry would be upset to a large extent, the whole energy of the people being concentrated on the war. But this turned out to be a false fear. The war does not so much affect our trade as we expected; transactions are done very smoothly; stocks which suffered from a fall for a short time have risen again to their prices, and factories enjoy their usual profit. Nor does it make our people so greatly excited as you may think, though we Japanese pride ourselves on being the most patriotic nation on earth. At home, our conversations are as merry and innocent as ever, and in the street we see nothing warlike except noisy newsboys delivering specials of happy tidings in the form of our brilliant victories both on land and sea. Business men and laborers are calmly attending to their own tasks, and there is no excitement among them. In fact, our people seem to rightly understand that it is an important duty on their part, especially at this juncture, to apply themselves to their business with as much assiduity as their soldiers do to battles. Such being the state of things in Japan, however long the war may last, her commerce and industry will not be much affected by it; nay, they will continue the progress they have been used to make during these past decades."

The above statement is especially interesting in view of the fact that Japan's commerce with the United States in the present fiscal year shows a marked advance over that of any preceding year, and for the twelve months ending June 30, 1904, will probably exceed 70 million dollars. Figures covering eleven months of the present fiscal year have just been issued by the Department of Commerce and Labor through its Bureau of Statistics. They show that our exports to Japan amounted to $22,594,713 during the eleven months of this year, as against $19,854,843 in the corresponding months of the preceding fiscal year; also that our imports from Japan touched their highest point for an eleven months' period, being $44,367,461, as against $41,833,351 in the eleven months of 1903, the previous high-water mark.



CAR DERAILED.

The cross-bar A, sliding on the rails, supports the car and prevents the jolting of the wheels over the ties. The flange C keeps the car on the track.

Exports to Japan from the United States reached their highest point in the fiscal year 1900, when the total was $29,087,475, due in a large measure to the extraordinary purchases of cotton by Japan in that year. In the following year, however, there was a drop of fully 10 million in the volume of our exports to Japan, though an upward tendency is again apparent, and for the eleven months ending May 31, 1904, the total is, as already stated, $22,594,713, and for the full year will be about 24 million dollars.

Since the year 1900 Japan has greatly reduced her importations of cotton from the United States, owing to the high prices, and has increased her importation of lower-priced cotton from India. In the eleven months ending with May, 1900, Japan imported 16½ million pounds of American cotton, valued at 12⅜ million dollars; and in the present fiscal year to date she has taken less than 24 million pounds of American cotton, valued at less than three million dollars.

Flour, refined mineral oils, cotton, paper and its products, paraffin and paraffin wax, electrical machinery, locomotives, sole leather, and unmanufactured tobacco form the major portion of our exports to Japan, and in all of these, except cotton and paper, there is a substantial increase over last year's exports.

[Continued from SUPPLEMENT No. 1488, page 23850.]

WATER-SOFTENING.*

AN INQUIRY INTO THE WORKING OF VARIOUS WATER-SOFTENERS.

By C. E. STROMEYER and W. B. BARON, of Manchester.

The Desrumaux Water-Softener.

THE apparatus, Fig. 7, consists of a cylindrical settling-tank and a cylindrical lime-tank. Over these is placed a distributor and a water-wheel which turns a hollow shaft reaching to the bottom of the lime-tank, where several stirrers are attached to it. The same water-wheel also actuates a crankshaft with a small scoop, which ejects the necessary quantity of soda solution out of the soda-tank, which is placed over the settling-tank. The settling-tank has a central mixing-trunk. Attached to the circumference of the settling-tank are several screw-shaped inclined plates, the inner edges of which touch the mixing-trunk. Higher up is a filter. At the discharge-water level there is a float which controls the water supply. There is also a lime-slaking tank over the lime-tank.

Capacity.—8,000 gallons per hour, worked at a rate of 5,000 gallons.

Dimensions.—Settling-tank, 12 feet 6 inches in diameter over angles; lime-tank, 4 feet 3 inches over angles. Height of tanks, 34 feet. Total height, 40 feet. Floor space, 16 feet 9 inches by 12 feet 6 inches = 210 square feet.

These softeners are said to be working in all parts of the world.

Working.—The water supply, which is controlled by a float at the delivery, enters the distributor and through two carefully-adjusted openings. One stream of water passes through the hollow shaft to the bottom of the lime-tank, and gets converted into lime water, which overflows into the mixing-shaft. The other water stream descends over a water-wheel to the mixing-shaft. The water-wheel rotates the stirrers in the lime-tower, and also causes the small scoop to throw definite quantities of soda solution into the mixing-shaft. The chemical reaction takes place here and the precipitate is formed. The partially cleared water then ascends the settling-tank, being carried round and round the helical plates. The sediment which is here formed slips toward the center and down the steep helical junction line. Before being discharged the water is filtered.

Supply.—Partly town water, partly brook.

Chemicals used per 1,000 gallons: 2.56 pounds lime, 0.59 pound soda.

The analyzed water was taken from a reservoir holding 730,000 gallons, which was filled in one week, viz., 144 hours, equal to 5,000 gallons an hour.

The users report that the apparatus has been giving satisfaction since 1901. The boilers are now opened out only after steaming 1,000 hours, equal to about four months at 60 hours per week. Growths of soda appear on the fittings, but the brass is not attacked.

Result of Chemical Analysis.—The supply is the same as that for the Archbutt-Deeley apparatus, but being collected at another time, its composition is slightly different. The hardness of the delivery is 4.3 deg., as against 2.3 deg. in the other case. This is chiefly due to a deficiency of the chemicals added.

The Doulton Water-Softener.

The apparatus, Fig. 8, consists of two cylindrical settling-tanks, with a filter in the upper part of one tank and a mixing funnel and tube in the other. The two tanks are connected near the bottom. Resting on these two tanks are three smaller ones—one for the milk of lime, one for the untreated water, and one for the soda solution. The lime and the soda tanks have stirrers driven by a water-wheel. Each tank has a pipe leading to the mixing-funnel. Above these three tanks is a shaft with a water-wheel and bevel-wheels which actuate the stirrer in the chemical tanks.

Capacity.—4,000 gallons per hour.

Dimensions.—Tank diameters, 6 feet; height of tanks, 14 feet 6 inches. Total height, 24 feet 3 inches. Floor space of tanks, 75 square feet.

* Paper read before the Institution of Mechanical Engineers.

Working.—Correctly determined quantities of soda and of burnt lime are mixed with hot and cold water respectively, and poured into their tanks. The water supply is then turned on, whereby the water-wheel is rotated and the fluids mixed. The connection from the center tank to the mixing-funnel is now opened, and as the water rises in the mixing-tank, the ball-regulator valves of the chemical-tanks open, and their contents also pass slowly into the mixing-funnel. Should the demand for purified water stop, the water rises in the funnel and causes the three ball-taps to close, and after a time the supply is also cut off automatically over the hard-water tank. Should the water supply be cut off, then, by the sinking of the balls of the taps, the chemical-tanks will close automatically. A supply of hard water, regulated by a ball-tap, flows into the lime-tank. The sediment which collects in the two settling-tanks is run off through two taps. The filtering material is occasionally renewed or washed.

Supply.—Well water.

Chemicals now used are caustic soda and carbonate of soda.

The users report that the water has not yet been used for feeding the boilers. The water does not injure brass fittings. The sponge filters give some trouble, and it is intended to put down two or three settling-tanks.

Result of Chemical Analysis.—The water treated by this apparatus was heavily charged with mineral matter, and although the chemical treatment was not correct, the temporary hardness has been reduced very low, viz., to 3.1 deg. The water is, however, very alkaline, due to the excess of soda, but there is no free carbonic acid.

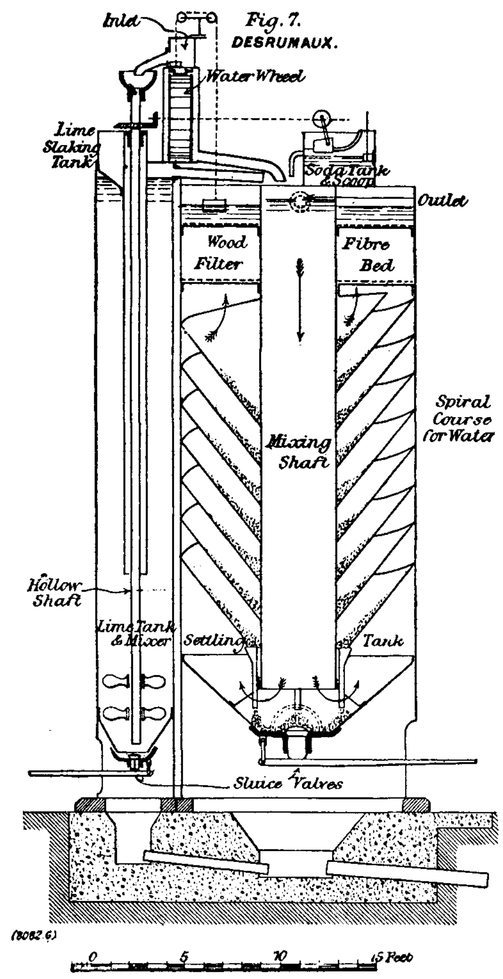
The Harris-Anderson Water-Softener.

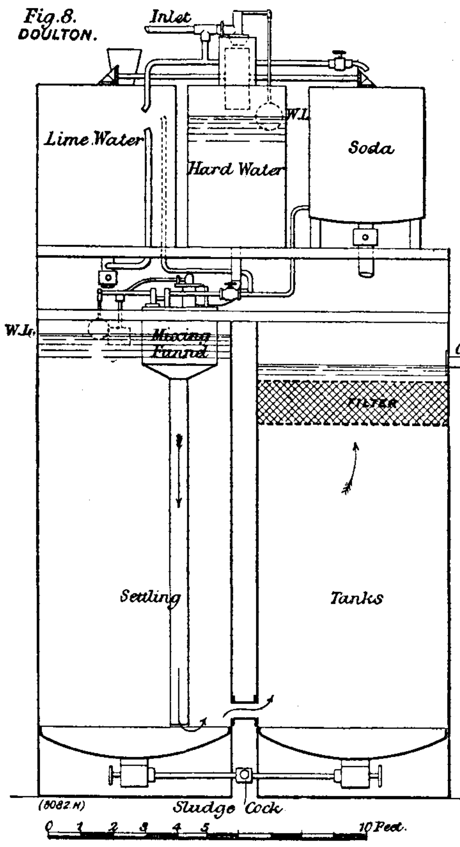
The apparatus, Fig. 9, consists of a distributor, a lime-tank, soda-tank, air-vessel and reaction tank, and settling-tank with a filter. The distributor has a circular weir, the water flowing from the circumference to three central compartments, and thence to the air-vessel, to the lime-tank, and to the soda-tank respectively. The air-vessel, by means of its siphon, acts as an air-pump and agitates the milk of lime in the lime-tank, in which pipes and cones are arranged for this purpose. The soda-tank consists of four cylinders, the solid soda being poured into a cage—the center one—while the water flows into the second inner cylinder, and, according to the strength of the low-lying soda solution, either passes straight down or overflows into the second cylinder.

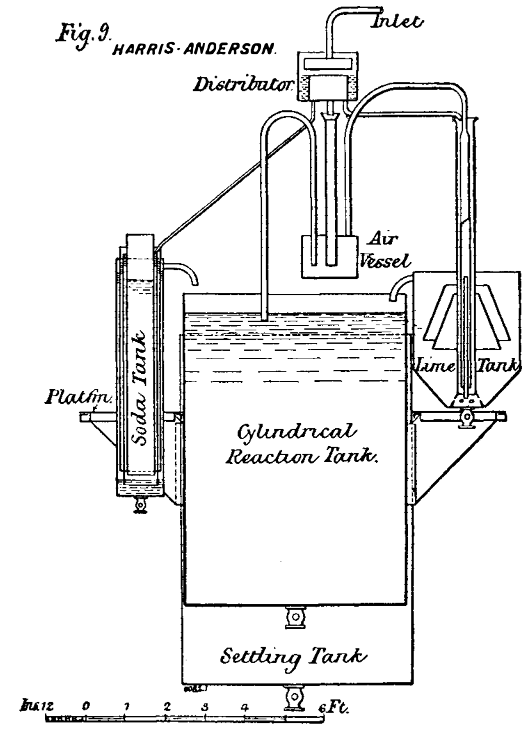
Capacity.—1,000 gallons per hour.

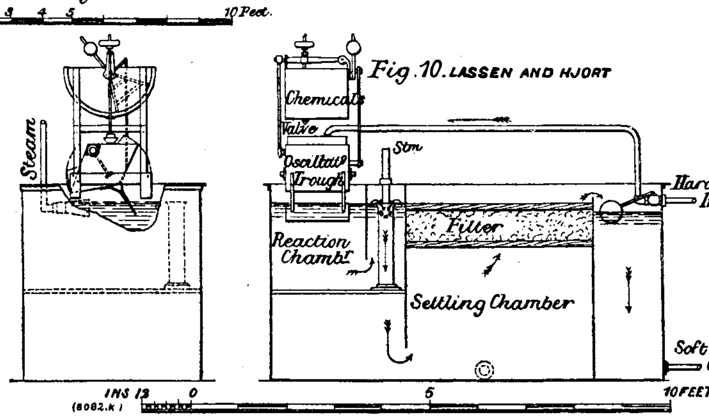
Dimensions.—Diameters of the reaction chamber and settling-tank are 5 feet 6 inches. The diameter over platform round reaction chamber is 11¾ feet. Total height from bottom of settling-tank to top of distributor, 17 feet 3 inches. Floor space of platform and settling-tank, 158 square feet.

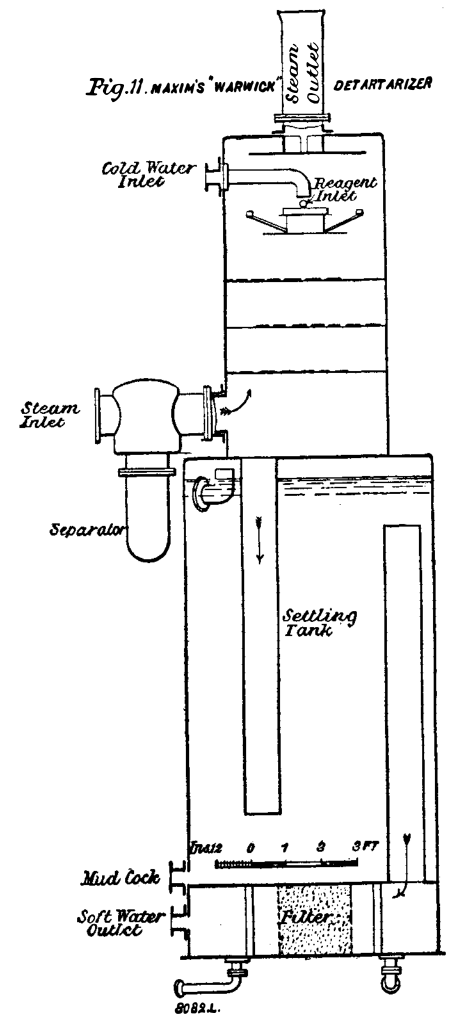
Working.—The water supply passes through a vertical turbine to the circumference of the distributor, thence over the circular weir, whose circumference is properly subdivided, to the air-vessel, to the lime-tank, and to the soda-tank. Alternately the water rises and sinks in the air-vessel and drives the air into the lime-tank, agitating the milk of lime, and then the water in the air-tank is siphoned out, and the action is repeated. The amount of water added to the lime regulates its supply, and can easily be altered by shifting the subdivision on the circular weir. The central cylinder of the soda-tank is filled with soda crystals, which partly dissolve in the water, the heavy soda solution settling at the bottom, as shown. A small but constant supply of water is run from the distributing-weir into the second cylinder, passing through the dense fluid at the bottom and up outside the third cylinder. Should, however, this rising soda solution be very dense, then the added water will flow over the top of the second cylinder and under the third cylinder. Thus, by adjusting

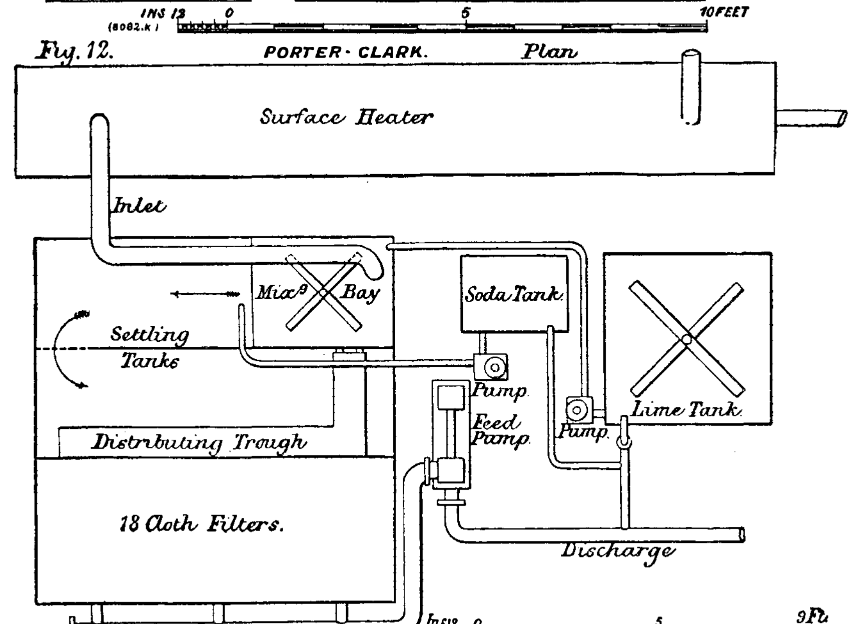












WATER-SOFTENING APPARATUS.

the height of the second inner cylinder, a soda solution of a definite strength is obtained. The sediment formed in the reaction chamber and in the settling-tank is run out through a sludge-cock.

Supply.—Pit water.

Chemicals used per 1,000 gallons.—2.25 pounds lime, 2 pounds soda crystals.

The users report that the apparatus works satisfactorily, and that no scale—only mud—is formed in the boiler. The soda solution maintains its strength, but the milk of lime loses about 14 per cent of its strength per hour.

Result of Chemical Analysis.—The water treated by this apparatus was also heavily charged with mineral matter, and, although an excess of soda was added, the deficiency of added lime resulted in a fairly high temporary hardness, viz., 6.20.

The Lassen and Hjort Water-Softener (Bruun Lowener).

The apparatus, Fig. 10, consists of one large tank subdivided into three compartments. a reaction tank, settling-tank, and filter. Immediately over the reaction chamber is a pivoted double-V-shaped oscillating trough, and above this is a semi-cylindrical chemical-tank with stirrer and a valve, both actuated by the oscillating trough. Steam is employed in the reaction chamber for heating and mixing. The untreated water is discharged immediately over the double-V trough, and when one side is full, it tips over and empties itself. In doing so a fin projecting down into the reaction chamber agitates the mixed water, and a small wheel on the top of the trough knocks against the bottom of a valve spindle, and raises it for an instant. The valve is situated in the bottom of the semi-cylindrical chemical-tank.

Capacity.—1,000 gallons per hour.

Dimensions.—Length over angle flange, 8 feet 8 inches. Width over angles, 4 feet. Height of tank, 4 feet. Total floor space, 48 square feet.

Working.—The chemicals—about 10 per cent lime and the necessary soda—are mixed with water, and are poured into the semi-cylindrical tank, and the supply, which is regulated by a ball-tap at the discharge, is turned on, and runs into one of the pivoted V chambers of the oscillating trough. When one side is full, the trough tips over, discharges its water, opens and closes the valve in the bottom of the chemical-tank, and by means of blades agitates the chemicals and the mixed water. If no steam is used, the settling-tanks have to be larger than shown. The quantity of chemicals discharged through the valve with each tilt of the trough is regulated by the length of the valve-rod. The chemicals, assisted by heat from the steam, cause the mineral matter to precipitate in the reaction and settling-chamber. The water then passes through the filter to the discharge.

Exhaust steam can be used.

Supply.—No. 1, town water; No. 2, well water.

Chemicals used per 1,000 gallons.—No. 1, 2 pounds lime, 1 pound soda; No. 2, 3.6 pounds burnt lime, 2.8 pounds calcined soda.

The users report that this softener works well. There is a little trouble with the valve in the chemical-tank, which sticks if the apparatus has been resting for some time. Unless this tank is kept at least half-full, the flow of chemicals diminishes.

Result of Chemical Analysis.—Two softeners were dealt with, but only one, referred to as No. 1 in the Analysis Tables (given later), is illustrated. In this case the proper chemicals were used, and a considerable total hardness has been reduced to a very low limit. No. 2 apparatus dealt with a still harder water, in which the temporary and permanent hardness were about equal, and both have been reduced to nearly the lowest limit, but, a large excess of soda having been added, the alkalinity is high.

The Maxim Water-Softener, "Warwick" Detartarizer.

The apparatus, Fig. 11, consists of two cylindrical vessels placed one above the other. The untreated water-supply pipe enters the top of the upper vessel, and ends in a spraying arrangement, while an exhaust steam-pipe, into which a grease-separator is introduced, enters the bottom of the upper vessel. The lower vessel acts partly as a settling-tank and partly as a filter.

Capacity.—3,000 gallons per hour.

Dimensions.—Diameter of lower cylinder over angles, 7 feet 6 inches; total height, exclusive of sludge-cocks and exhaust-pipe, 24 feet; floor space, exclusive of grease-separator, 56 square feet.

Working.—The hard water enters the upper chamber through a valve which is regulated by a float on the discharge. The necessary amount of soda solution is injected into this water by means of a pump connected to the feed. This water comes in contact with exhaust steam from the engine, from which most of the grease has already been removed by a grease-separator. The water thereby acquires a temperature of about 212 deg. Fahr. The condensed steam is added to it, and it then falls into the lower tank. The heat and the soda cause the mineral matter to be precipitated, and the grease adheres to the sediment. As a safeguard a filter is fitted. The sludge is occasionally run out of the cocks in the lower tank.

Supply.—Pit water.

Chemicals used.—Soda—quantity not stated.

The users report that they are well pleased with the softener, and now have two at work. Partly because the boilers are now free from scale, partly because their feed is now heated to 200 deg. Fahr., the softeners have paid for themselves in twelve months' time.

Result of Chemical Analysis.—The analysis shows that only 6 to 11 per cent condensed steam was added to the supply. By subtracting 6 per cent of pure water, the values in the third column of the Table of Analysis are obtained. It will be seen that the slightly deficient carbonate of soda has converted nearly all the permanent hardness into temporary hardness, and that the small quantity of steam combined with a probably low temperature had no power to drive off the carbonic acid, which now held nearly 26 grains of carbonate of lime and magnesia in solution. Caustic lime or caustic soda ought to have been added to this water.

Porter-Clark Water-Softener.

The apparatus, Fig. 12, consists of several tanks placed side by side. The surface heater fitted at these works is not an essential feature of the softener. At the right-hand corner is the lime-tank, next to it is the soda-tank. The large tank is subdivided into a mixing-tank, a settling-tank, and next to it are the cloth filters. An engine-driven shaft passes over the lime, soda, and mixing-tank, and by means of bevel-wheels actuates the stirrers. It also drives two small iron pumps which draw from the chemical-tanks. The lime solution discharge is near the inlet of the untreated water. The soda discharge is at the outlet of the mixing-tank. There is a collecting trough at one end of the settling-tank, and adjoining it are eighteen cloth filters.

Capacity.—3,000 gallons per hour.

Dimensions.—Lime-mixer, 4 feet 9 inches square and 5 feet high. Soda tank, 3 feet by 2 feet by 3 feet high. Mixing-tank and settling-tank, 10 feet by 6 feet by 5 feet high. Filter, 10 feet by 5 feet by 5 feet high. Floor space, 152 square feet. Heater, 3 feet in diameter and 21 feet long.

Working.—The water, after passing the surface heater, enters the mixing-tank, where it gets mixed with milk of lime, which is pumped into this tank in the correct proportion. The partly-treated water while flowing out of this tank is mixed with a regulated quantity of soda solution and slowly passes along the settling-tank, where most of the precipitate is deposited. It then overflows into a distributing-tank, and thence on to the cloth filters and to the feed-pump.

Supply.—Not stated.

Chemicals used per 1,000 gallons.—7 pounds lime putty and 1.5 pound soda crystals.

The users report that the water was intended more for washing purposes than for boilers; in these some pitting was noticed. Subsequently the softener was replaced by another patent.

Result of Chemical Analysis.—In this case the supply had much temporary and permanent hardness, but as only half the necessary quantity of soda was introduced, the result was naturally very unsatisfactory, and it is impossible to judge how the apparatus would have acted if properly worked.

The Pulsometer Water-Softener (Criton).

Working.—Details from which to make a sketch of this softener were not obtainable, for this company have redesigned their softener since the samples were analyzed. The flow of water and chemicals was regulated by siphon and ball-taps.

Supply.—Well water.

Chemicals used.—Lime, but the quantity is not stated.

The users were apparently not aware that they had no permanent hardness in their supply, and they report that they formerly added soda; this naturally caused their boiler fittings to give trouble, which has now ceased. No scale, only mud, is formed in the boiler.

Result of Chemical Analysis.—The water treated was alkaline, and had no permanent hardness. No soda was, therefore, added. Unfortunately, an excess of lime was used, which produced 2 grains of caustic soda, and which accounts for the resultant high temporary hardness and high alkalinity. An addition of water having permanent hardness would have improved the product.

(To be continued.)

CONTEMPORARY ELECTRICAL SCIENCE.*

Sensation of Light Produced by Radium Rays.—W. B. Hardy and H. K. Anderson have investigated the sensation of diffuse light produced when a few milligrammes of a salt of radium are brought near the head in the dark, with the object of determining the place of origin of the sensation and identifying the particular rays which cause it. The sensation may be described as an appearance of diffuse light of steady intensity disposed in the external space in front of the head and filling that space fairly or quite uniformly. If the radium, covered, of course, with some opaque screen, such as, for instance, black cardboard, to cut off the pale light which it emits, be held in front of one eye, one notices that the intensity of the glow is considerably reduced by closing the eyelid. When the eye is open it is possible in a very general way to locate the radium from the fact that the sensation is strongest when the axis of vision is directed to it, and diminishes when the head is turned to one side. The sense of direction arises solely from variations in the intensity of the glow, and not from variations in its quality. When the eye is closed the sense of locality is completely lost. This is due to the fact that the glow is due to the β and γ-rays, and that the eyelid is peculiarly opaque to the former, stopping apparently the whole of them. The γ-rays, on the other hand, having a very great penetrating power, pass almost equally well through the eyelid or through the bones and other tissues forming the orbit. The rays produce no effect on the visual purple. The sensation is due, not to an action on the brain or the optic nerve, but on the retina. The latter probably does not respond directly to the radium rays, but to light rays, which are given out by the tissues of the eyeball—chiefly the cornea and lens—when they are traversed by the β and γ-rays. The fresh lens of a sheep, ox, or rabbit was found to glow strongly when exposed to the rays. The cornea and vitreous humor also glow, but to a less extent, and the retina itself gives a strong glow. The sclerotic, on the other hand, glows very slightly. The glow of the lens alone is so striking as fully to account for the sensation of light produced by the rays.—Hardy and Anderson, Proc. Roy. Soc., November 21, 1903.

Loss of Potential in the Arc.—A timely investigation of the potential drop at electrodes composed of various metals has been made by G. Schulze, who has examined no less than 20 metals, and arrived at some interesting conclusions which corroborate the theoretical speculations of Stark. Owing to the rapid melting of most of the metals, they had to be held in a lower carbon electrode hollowed out to receive them. The metals of the alkalies and alkaline earths, as well as those of the iron group, with the exception of iron itself, acquired a crust of oxide at once. Bismuth, lead, tin, antimony, and silver furnished a metallic electrode, and iron furnished two arcs, one proceeding from the iron, and the other from the iron oxide. In these circumstances, it was only possible to compare metals belonging to the same group. It was then found that within the same group in the periodic series of elements the anode drop increased inversely as the atomic weight. The author maintains that quantities of electricity, such as are conveyed by strong currents, can only pass from a solid or a liquid into a gas when the body evaporates at one electrode and is precipitated on the other. This makes the passage of electricity through gases analogous to its passage through an electrolyte. At the point where the arc appears attached to the electrode the metal is boiling. On doubling the current strength the area of the point of attachment is not necessarily doubled, since, as it increases in size, a smaller proportion of the heat is conducted away by the surrounding portions, and the temperature has a chance of increasing.—G. Schulze, Ann. der Physik, No. 12, 1903.

Magnetic Properties of Revolving Electrons.—J. J. Thomson discusses the magnetic field due to a number of negative electrons situated at equal intervals round the circumference of a circle, and rotating in one plane with uniform velocity round its center; and the effect of an external magnetic field on the motion and periods of vibration of such a system. The discussion is intended to elucidate the theory that the atoms of the chemical elements are built up of large numbers of electrons revolving round the center of a sphere filled with uniform positive electrification. The author confirms Voigt's conclusion that the magnetic properties of bodies cannot be explained if we suppose that the force is proportional to the distance from a fixed point. The same result applies as long as the force is central and there is no dissipation of energy. But if the motion of each particle is resisted by a force proportional to the velocity, a collection of such particles will be paramagnetic, the particles tending to fall to the center of the orbit. Suppose the atoms of a substance, like the atoms of a radio-active substance, were continually emitting electrons, but with insufficient velocity to carry them clear of the atom. They would then fall back into the atom with but little energy, and a system consisting of such atoms would be paramagnetic. The temperature of the body would rise at the expense of the atomic energy, and the temperature in the center of a mass of iron should be permanently higher than the temperature at the surface. The author hopes shortly to test this point.—J. J. Thomson, Phil. Mag., December, 1903.

Spectrum of Glowing Radium.—Sir William and Lady Huggins pointed out already that at least seven lines in the spectrum of radium bromide glowing at ordinary temperatures agree with corresponding lines in the band spectrum of nitrogen. With a longer exposure they obtained further coincidences, some of the fainter single lines of the nitrogen spectrum coming out in the radium bromide spectrum. The presence of negative-pole bands in the spectrum of nitrogen when excited by radium naturally suggests whether the β rays, which are analogous to the cathode corpuscles, may not be mainly operative in exciting the radium glow. On this surmise it would be reasonable to expect some little extension of the glow outside the radium itself. The authors were unable to detect any halo of luminosity outside the limit of the solid radium bromide; the glow appears to end with sudden abruptness at the boundary surface of the radium. It may be that it is only at molecular distances, and at the moment of their formation, that the rays can excite the nitrogen molecules. If, as suggested by Rutherford, the α-rays are connected with helium, the experiment seemed worth making of taking a photograph of the spectrum arising from their bombardment upon a zinc sulphide screen. It seemed possible, though not very probable, that the encounters of these bodies, at the enormous speed at which they travel, with the molecules of air, and their final collision with the screen, might on that hypothesis give rise to some of the radiations peculiar to helium and so produce its spectrum on the plate. The result of the experiment, so far as concerns helium, was negative; which must not, of course, be interpreted as excluding the presence of helium, but only as showing that, if present,

* Compiled by E. E. Fournier d'Albe in the Electrician.

the conditions are not favorable to the appearance of its spectrum.—Sir W. and Lady Huggins, Proc. Roy. Soc., November 21, 1903.

ELECTRICAL NOTES.

The question of auxiliary plants is one which in modern transmissions assumes no little importance, and is the source of many worries. Auxiliaries may be required for three quite distinct purposes, each of which points at special directions of development. First, an auxiliary plant may be required purely for use in emergencies to carry more or less of the load, in case of premeditated repairs to the main line plant or in the sub-station. Second, it may be required to help the plant over the peak of the load now and then, as well as for the former purpose. Third, it may be installed to assume part of the normal load at certain seasons of the year. In each case it is available to a certain extent in the event of an accident to the system. The auxiliary plant of the first class is established for purely temporary use as a convenience in the ordinary contingencies that arise in every hydraulic plant. It is not intended to assume any considerable part of the load, but to go into use at times when the load is normally light, as during a part of Sunday or during the very early morning before the motor load comes on. It happens now and then that some repairs must be executed which cannot be put through without a temporary shut-down, the time for which can be chosen beforehand. A comparatively small auxiliary, perhaps not more than 10 or 15 per cent of the full load capacity of the system, will answer admirably for this simple purpose, its proper size being determined by the characteristics of the load. Cheap and simple apparatus will answer the purpose here, for in such temporary use the matter of operating economy is secondary. A small steam plant at or near a sub-station is the simplest way out of the difficulty in many cases, although there is much to be said in favor of a storage battery and reversible rotary, particularly if the plant is hard pushed at times of maximum load. The storage battery has, during the last few years, passed from a condition of doubt and uncertainty into clear recognition as a valuable adjunct in central station operation. If a transmission plant has a bad peak in its load line a battery can be put to extremely good use in furnishing both an auxiliary in case of needed repairs and a source of additional power during the peak. It is far better suited to this use than to assume merely the function of an occasional auxiliary, or that of a reserve plant during periods of low water, or the like. The first cost of the battery is rather high, and to keep it in first-class order it should be regularly used. If the conditions of the load demand, therefore, a very large use of the auxiliary, or very infrequent use, or both, the battery works somewhat at a disadvantage. When, on the other hand, the chief use of an auxiliary plant is to deal with periods when a transmission plant is suffering from low or high water, a steam plant becomes a necessity, unless local conditions are such as to give the big gas engine an advantage over steam. Hydraulic plants vary greatly in their need for this kind of assistance. In some instances the serious shortage covers only a few days in each year, and the lesser shortages can easily be covered by storage. In other cases there may be a month or so of moderately low water during which help is needed. Again, some plants suffer only during a few days of flood, which backs up the water and reduces the working head. Each case has to be treated on its merits, and there is a gradual passage of the conditions toward those in which more or less auxiliary power is needed most of the time. Such mixed power plants are rather in a class by themselves, and a volume might be devoted to their development.—Dr. Louis Bell, in Cassier's Magazine.

Dr. E. Bose, of Goettingen University, has for two years past made a close investigation of the simplest possible case of a chemical action of cathode rays, with a view to ascertaining whether or not the chemical conversion due to the rays is a purely electro-chemical phenomenon according to Faraday's law. A solution of caustic potash, saturated in the hot state, was exposed for a long time to the effect of cathode rays in a convenient outfit of large electrolytic surface, when a reduction attended by the formation of hydrogen was noted. The amount of electricity absorbed by the electrolyte was measured with the aid of a hydrogen voltmeter under reduced pressure, this electricity being drawn off through a platinum electrode sealed into the bottom of the testing tube. As the hydrogen present in the vacuum where the discharges took place was partly dissociated into hydrogen and oxygen, a mixture of hydrogen and oxygen containing hydrogen in excess was withdrawn by means of the mercury air pump; and after the gases due to this dissociation were eliminated by an explosion, the hydrogen in excess could be measured, and its pure condition confirmed. The chemical effect of the cathode rays following Faraday's law being a purely electrochemical phenomenon, the amount of hydrogen derived from the vacuum should be strictly the same as the one evolved in the voltmeter. A high degree of accuracy, it is true, was not to be anticipated on account of the smallness of the effects and amounts of electricity in question, but the invariable result of the experiments was in opposition to the above hypothesis. There must, therefore, be, besides the electrochemical action, another chemical effect of cathode rays, due obviously to the kinetic energy of the cathode ray particles, this hypothesis being borne out by the theoretical considerations of the author. It is shown that, in the most favorable case, an amount of hydrogen even 1,600 times the electrochemical amount would be obtained, but it should be remembered that in most cases the greater part of the kinetic energy of the rays is simply transformed into heat. The author thinks his experiments to be likely to bring about an agreement between existing divergent views as to chemical or physical character of the effect exerted by cathode rays, as both kinds of effects seem to be present at the same time. Similar conditions will be met with in the case of Becquerel rays, though on account of the higher living force, the dynamical effect is likely to prevail much more. On the other hand, passing to slower cathode rays, the dynamical-chemical effect should play a more and more secondary part, an effect of practically purely electro-chemical character being eventually noted. The author thinks even other forms of electrical discharges in gases to be likely to afford interesting material for the investigation of the electrochemical effects of electrons, allowing of a theory of electrochemistry without metallical electrodes being elaborated.

SCIENCE NOTES.

The New York State Department of Paleontology has removed for the State Museum a very large and fine specimen from the rocks at Bidwell's Crossing near Sciota. The rock is the Potsdam sandstone, which formed the earliest beach sand about the little continent made by the Adirondack Mountains when nearly all the rest of the world was beneath the sea level. Over this shelving beach, which was exposed at the ebb of the tide, crawled the great trilobites or crabs of the primordial seas, leaving broad corrugated sinuous trails resembling traces of great serpents. Every now and again the creatures rested, and then, swimming off in the rising waters, left the large oval imprint of their bodies at the end of the trails. This exposure of the Potsdam sandstone has been known for some time to the people in the vicinity, but only lately has it been deemed important to place the specimen where it can be easily accessible to the public. This remarkable specimen measures nearly forty feet in length by twelve feet in width and weighs about twenty tons.

Prof. Frederic B. Loomis, of the biological department of Amherst College, has returned from a trip of three months spent in the "Bad Lands" of Dakota and Wyoming, searching for the remains of extinct animals and fishes. Six weeks were spent in the Bad Lands between the Cheyenne and White Rivers. Here were found the fossil remains of many animals, including the rhinoceros, horse, camel, beaver, and rabbit. In all, the remains of some 500 animals, or parts of animals, were found, and Prof. Loomis says there are some choice specimens. One of an extinct animal known as the Titonothere, nearly as large as an elephant, was found in such a complete state that it can be set up. Another smaller animal known as the Oreodon, a sheeplike animal, was found with only its toes lacking. Forty to forty-five skulls of animals were found, the other parts of the animals being missing. Eastern Wyoming was visited in a search for sea animals, of which some choice specimens were found. One known as the Ruosasaurs was found in a good state of preservation. It is a fish as large as a whale. Many specimens of the salmon tribe were found.

E. H. Hawley writes to Science on primitive flageolets as follows: "There is a kind of primitive flageolet made by the western tribes of North American Indians as follows: A section of cane is open at both ends, but has a joint between the ends; the septum of this joint closes the tube. Two holes from three-sixteenths to one-fourth of an inch in diameter are made from the outside into the cavity, close to and on opposite sides of the septum. A shallow air channel is cut in the outside of the cane from one hole to the other, and three, four, or six finger holes are made in the cane in the part below the septum. The Rees and Shoshones make a septum of wax. When so constructed and nothing further added the 'mystery flute,' described by early writers, is completed when the upper of the two holes at the septum and the air channel are covered by a finger. Blowing through the cane from the upper end produces a sound whose pitch is changed by the finger holes. The mystery consists in placing the finger over the upper hole and air channel exactly in the correct place. Usually a piece of cloth, skin, etc., is tied around the cane at this point. The National Museum has specimens of this instrument from the following tribes, viz., Apaches, Cocopas, Mohaves, Papagos, Pimas, Rees, and Shoshones. Other examples have a tube with septum made by splitting a cylinder, excavating the halves, and gluing them together. I had supposed until recently that this method of constructing the flageolet was not to be found outside of North America. I have never read a description of this instrument except from travelers in North America. But recently in a collection of specimens made by Dr. W. L. Abbott, at Siaba Bay, Island of Nias, off the west coast of Sumatra, I find a specimen made in the manner stated above except that in the place of a septum the bore of the cane is plugged with wax. The covering of the upper hole and air channel is a long leaf wrapped around and protected by a bandage of cotton sheeting. It has seven finger holes and a thumb hole. Its Malay name is Siro'oni."

ENGINEERING NOTES.

A select committee of the House of Lords are considering a proposal to deepen the Manchester Ship Canal, and to raise the low-water level of the rivers Weaver and Mersey. Mr. Balfour Brown, K.C., in stating the case for the promoters, said that at present the depth of the canal was only 26 feet. In recent years the size of vessels had enormously increased, and a greater depth of water was now absolutely necessary. When the depth of the canal was fixed at 26 feet there were not half a dozen vessels built which could not get up the canal. Now hundreds of vessels were too large to navigate the canal. The deepening proposed would enable vessels of 11,500 tons dead weight to navigate the canal.

After twenty-eight months of investigation of the oil fuel problem, the Navy Board has put its stamp of approval on oil as a fuel and has recommended the appointment of a commission representing the maritime, commercial, manufacturing and naval interests for the purpose of formulating such rules and regulations as would provide for an economical, efficient, enduring, and safe oil-fuel installation. This board consists of Commander John R. Edwards and Lieutenant-Commander W. M. Parks and F. H. Bailey, and in their report they announce that the engineering and mechanical features of the liquid fuel problem have been satisfactorily solved. Financial and supply features are now, says the report, the only hindrances to the use of crude petroleum as a standard fuel. As the available supply of crude petroleum is only three per cent of the world's demand for coal and other fuel, the board has suggested that for a time there should be an effort to restrict the use of oil for fuel to special purposes in particular localities. The report gives detailed information concerning some particular devices for satisfactorily burning the oil, and makes it clear that there are many devices for this purpose which may be regarded as satisfactory and states that there seems to be no prejudice among engineers to the use of oil as fuel.

Although steel wire is rapidly replacing other materials for ropes for mine use, ropes of vegetable fiber still hold a place among installations of minor importance and are worthy of some description here. In Belgium, where the textile industries have been highly developed and have always occupied an important place, some of the largest hoisting plants use manila rope. The best of the fibers used in the manufacture of cordage is the so-called manila hemp. This is not hemp, but is the fiber of the leaf stalks of the *Musa textilis* or "textile banana." The entire supply comes from the Philippine Islands. It is called by the natives "abaca," and in many books is erroneously called "aloe." This fiber is very strong and durable, but not very flexible. It is therefore ill adapted to the manufacture of small cordage, though it is very satisfactory for the larger sizes. When dry it contains 12 per cent moisture, and it will absorb as much as 40 per cent in a damp atmosphere. Moisture, however, does not tend to promote the decay of this fiber. In fact, in hot, dry situations an occasional wetting of the rope is thought to prolong its life. A freezing temperature renders the fiber brittle. The hardest and strongest fiber is that from the outer layer of leaf stalks. That from the inner layers is increasingly fine and weak. The butts of the fibers are stronger than the tops. Next in importance is the common hemp, which is the fiber of the stalk of the plant of that name. It is grown throughout Europe, in India, and in some parts of America. The kind best adapted to the manufacture of cordage is that grown in Russia. This fiber is more flexible than manila hemp, but less strong and less durable. It decays very rapidly if kept wet. A tarred hemp rope immersed in water is stated to have lost in four months nine-tenths of its strength. Hemp is also injuriously affected by the bad air found in some mines. In order to protect them to some extent against the action of these destructive agents, ropes made of this material are often tarred, either after completion or in the yarn. The proportion of tar should not exceed 20 per cent. This operation seriously reduces the strength of the fiber but increases its durability. It has been recommended that a tarred hemp rope should not be used until six months, or even a year, after its manufacture. This period of rest allows the tar to become uniformly distributed throughout the fiber, and the English Admiralty Board states that the rope has 10 per cent greater durability than if it is used as soon as made. Manila ropes are never tarred. Other fibers commonly used in rope making are "sisal hemp," the fiber of the *Agave Sisalana* of Central and South America; "phormium hemp," fiber of the *Phormium tenax* of New Zealand; "sunn hemp," fiber of the bark of the *Crotalaria juncea* of India. The last is also called "Bengal hemp," "brown hemp," or "Bombay hemp." These fibers are valuable in the order named. Not one of them, with the exception of the common hemp, is entitled to the name "hemp." The name has become attached to them from the fact of their being used for the same purposes as the true hemp fiber. On account of its cheapness, jute is frequently worked into cordage nominally composed of some other material. It is the fiber of the inner bark of an Indian plant. It is long and fine, but weak, and decays very rapidly under the action of water. It is always to be regarded as an adulteration. Coir, the fiber of the outer husk of the cocoanut, is occasionally used in cordage manufacture. It is quite strong, but is short, stiff, coarse, and rough.—C. W. Comstock in Mines and Minerals.

TRADE NOTES AND RECIPES.

Patent Leather Dressing.—

Rosin	1 ounce
Venice turpentine	1 ounce
Oil of turpentine	1 ounce
Sandarac	2 ounces
Shellac	4 ounces
Lampblack	4 drachms
Alcohol	24 ounces

Birmingham Platina, a Species of White Brass.—This is an alloy of a pure white, almost silver-white color, remaining unaffected by tolerably long exposure to the atmosphere. Unfortunately this alloy is so brittle that it can rarely be shaped except by casting. It is used only in the manufacture of buttons. The alloy is poured into molds giving rather sharp impressions and allowing the design on the button (letters or coats-of-arms) to stand out prominently with careful stamping. The composition of this alloy, also known by the name of platinum-lead, is as follows:

	I.	II.
Copper	46.5	4
Zinc	53.5	16

—Der Metallarbeiter.

Steel Tools in Aluminium Work.—Owing to its excessive softness, aluminium is apt to ruffle when being turned, planed, or filed, and the edge of the instrument becomes dulled from particles of aluminium adhering to it. In consequence, the aluminium is torn rather than cut, and the edges easily become rough and uneven. This can be prevented by taking only small portions or chips at a time, and dropping oil plentifully and continuously on the metal and the steel. With regard to filing, it should be noted that cross-cut files quickly become clogged, much more so than single-cut files. The quickest way to clean files is to place them in concentrated soda-lye, washing them thoroughly in running water, and drying them immediately afterward in sawdust. More satisfactory results are obtained in many cases by grinding with soft and granular sandstone than by filing, turning, or planing. Cutting off smaller from larger pieces is best effected by means of a cutting-file. With a well set and oiled circular saw the metal can be cut as easily as wood. A chisel will slip on the soft metal more than on glass or diamond. This can be avoided by sprinkling with a mixture of 4 parts oil of turpentine and 1 part stearic acid (or olive oil with rum).—Der Metallarbeiter.

Cleaning and Preserving Medals, Coins, and Small Iron Articles.—Fr. Rathgen (in the Chemische Zeitung) says that coins, medals, etc., as well as small iron articles, may be cleaned as follows:

The coating of silver chloride may be reduced with molten potassium cyanide, then boil the article in water. Displace the water with alcohol, and finally dry off in a drying closet. When dry brush off with a suitable brush (soft, like a jeweler's) and finally cover with "zaponlack" (any good transparent lacquer or varnish will answer).

Instead of potassium cyanide alone, a mixture of that and potassium carbonate may be used. Delicate objects of silver become, after treatment in this way, less brittle. Another way is to put the article in molten sodium carbonate and remove the silver carbonate thus formed, by acetic acid of 50 per cent strength. This process produces the finest possible polish.

The potassium cyanide process may be used with all small iron objects. For larger ones molten potassium rhodanide is recommended. This converts the iron oxides into iron sulphides that are easily washed off, and leaves the surface of a fine black color.

Practical Introduction to Picture Reproduction by the Use of Luminous Pigments.—Daily papers as well as trade journals have repeatedly called attention to processes which render it possible to reproduce pictures from books by phosphorescent light. Particular stress was laid upon the fact that with the aid of this or that simple process photographs might be taken or negatives made of pictures in books without removing the books from their place in the library. If we do not agree altogether with this statement, it is nevertheless undeniable that by means of phosphorescence reproductions may be as well made as with daylight. To make a test of this process, smear a piece of cardboard with luminous paint and expose it for a time to sunlight or the rays from an electric arc. Place this now against the back of the picture to be copied. Upon the front of the picture place either a dry plate, film, or sensitized paper, film side down, close the book and let it remain so, according to the thickness of the paper upon which the picture is printed, from 10 minutes to an hour. It would be of advantage if the book in question could be weighted down with other books. When the time has elapsed the operation will be complete and the further treatment of the negative is precisely the same as that of one made in the ordinary way. If neither sunlight nor the electric arc is available, the pigment may be made self-luminous by exposing it to a magnesium light. A dark room is indispensable here, for the plate or bromide paper must be inserted in the book without exposure to light, to be removed under like conditions. The chief advantage claimed for this process—the ability to reproduce the pictures without removing the books from their places in the library—becomes void. To make the picture with a camera is decidedly more practical. Let it be understood that pictures to be reproduced by the phosphorescent process must not be printed on the back. Wood cuts or steel engravings are best for this purpose.—Neueste Erfindungen und Erfahrungen.

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