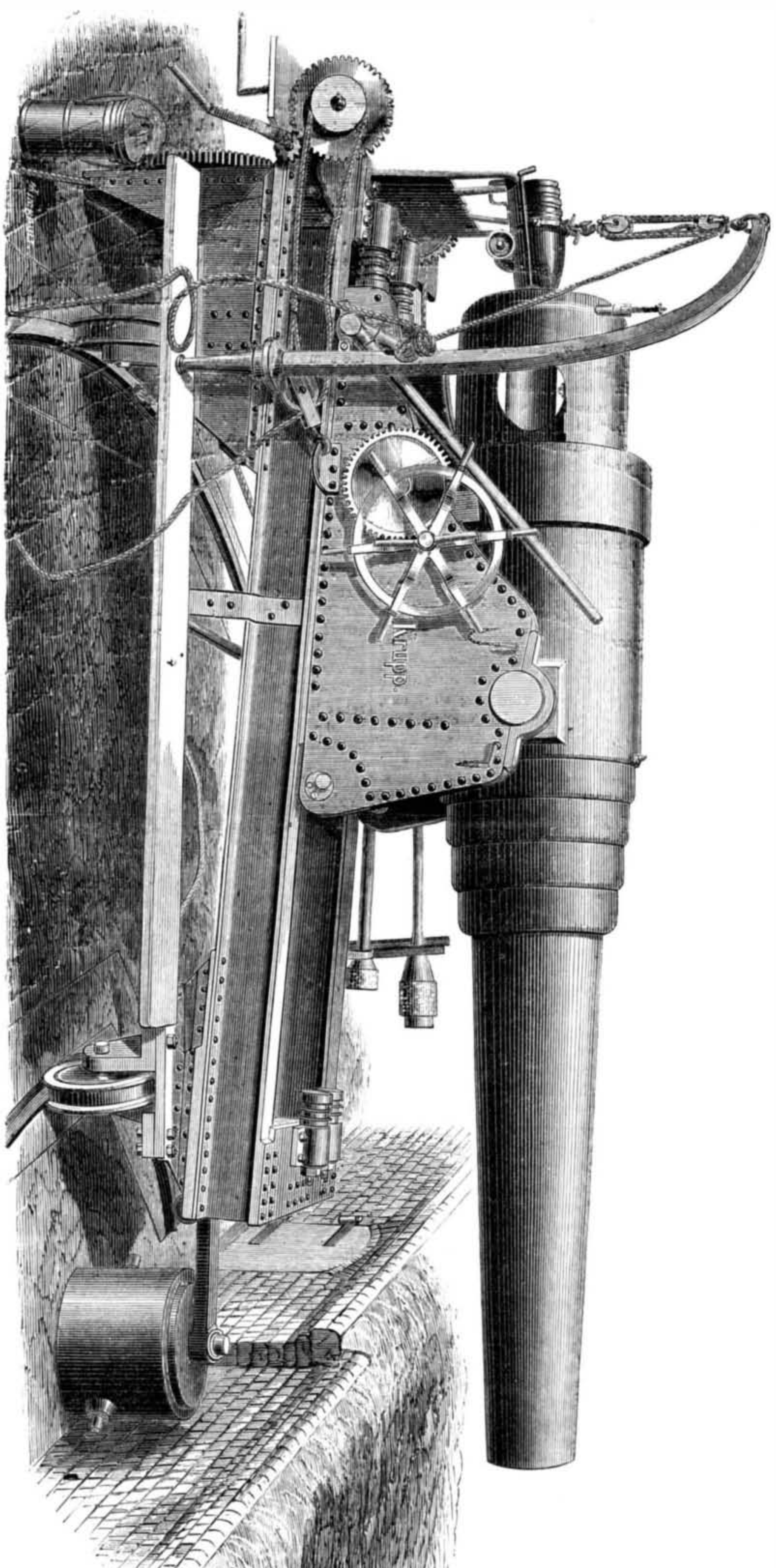
MODERN GERMAN ARTILLERY.

Our engraving represents a 10 inch 22 tun cast steel gun, manufactured by Krupp, the celebrated founder of Essen, Prussia, and now in use in the German artillery service for coast defence. The arm is made of two layers of rings or hoops over the barrel, and fires a shell of 423 pounds, with a charge of 66 pounds of powder, at 1,200 yards, through an 8 inch armor plate. The illustration shows the gun mounted in a sea fort, and resting on a thick bed of concrete so as to fire over an earth breastwork 40 feet thick, the muzzle of the piece being 7 feet above the platform. A tramway, not shown in the engraving, runs behind the guns upon the terreplain, upon which trucks loaded with projectiles, after being hoisted up from the casemate below the gun platforms by means of a hydraulic lift, carry the required ammunition to the battery. The trucks are so high that the projectiles can be rolled from them direct upon the platform, where two davits with tackles receive them and lift them up to the breech. In the engraving a shell is shown just entering. The arrangements are said to be so perfect that six men are sufficient to fight a 10 inch gun, and for a long time can fire once every 1½ minutes, or about 40 rounds per hour.



THE KRUPP 10 INCH CANNON.

NEW GEOLOGICAL DISCOVERY.

During the recent voyage of the Challenger, a discovery has been made, the significance of which must strike every one who gives the matter even a passing thought; but to those who possess a knowledge of chemistry or geology this discovery is of peculiar interest.

In sailing from Teneriffe, off the west coast of Africa, to St. Thomas, one of the outlying West Indian islands, the soundings indicated that the bottom of the Atlantic rose into a ridge about 300 miles west of Teneriffe, and that from that, where the depth was 1,500 fathoms, it sloped gently down until, at 750 miles west of Teneriffe, it had sunk to a depth of 2,950 fathoms. From this point to within 300 miles of Sombrero, the depth was pretty constant, and for 1,800 miles the explorers seem to have been sailing over what geologists term a plain of marine denudation.

A remarkable relationship was found to subsist between the depth and the character of the dredgings. When worked on the 1,500 fathom ridge, the dredge brought up *globigerina* ooze, multitudes of minute shells, and fragments of coral, the whole, with the exception of a few silicious sponges, being composed mainly of carbonate of lime. As the depth increased, the proportion of these shells regularly diminished, until in the deep water they had altogether disappeared, and the dredgings then consisted of a fine, red mud which did not effervesce with acid. This red colored deposit of the silicates of peroxide of iron and alumina was met with everywhere all over this vast submarine plain; everywhere it had the same unmistakable appearance; it could not, therefore, be the fine sediment brought down by rivers and carried out to sea, slowly settling in deep water, for then it must have differed in different localities; the absence of currents, too, as well as the great extent of the deposit, precluded this view of the origin. Another remarkable feature of this area was the absence of those pelagic shells which are littered in such numbers over all other parts of the bed of the Atlantic.

How, then, was this gradual disappearance of shell to be accounted for? Why was it that on this red mud area the shells of those animals that frequent surface waters were not found, since, when these creatures die, their shells must inevitably fall to the bottom? Whence came this enormous accumulation of impalpable clay?

Air dissolved by water is richer in oxygen and carbonic acid than the air of the atmosphere. The ratio of the carbonic acid to the total amount of dissolved gases is greater in water taken from a depth than in surface water.

If, to the depth of 3,000 fathoms, the amount of carbonic acid keeps on increasing, relatively to the other dissolved gases, in a ratio at all comparable with that indicated by the foregoing analyses, it is easy to see that the water at this depth, under such enormous pressure, must be capable of dissolving a large quantity of those solid substances which, like carbonate of lime, are soluble in water containing carbonic acid. It is clear, too, on account of both the pressure and the amount of carbonic acid being less, that water near the surface must possess a much feebler solvent power than water at a great depth. This being the case, we should expect to find more lime-secreting organisms in the shallower than in the deeper parts of the ocean; now, as has been seen, this is exactly what was found by the explorers in the Challenger.

Under these circumstances, Professor Thomson concludes that this vast deposit of fine red clay is neither more nor less than the insoluble portion of myriads of shells, the residue, in fact, of a chalk formation now dissolved.

It appears then that, just as the higher regions of the Alps or the Andes are buried beneath a pall of eternal snow, so the higher regions of the sea bed are covered by a layer of grayish white ooze, prolific in organisms whose vacated shells will one day form chalk; and just as at the edge of the snow sheet the glacier melts away into a liquid, ocean-seeking stream, so, where the chalky covering of the sea bottom descends into submarine valleys, it descends into ocean, leaving behind it the red mud, like a terminal or bottom moraine.

Suppose, now, that a geologist should come across an ancient ocean bed, undisturbed by volcanic eruptions and undefaced by denudation: he would expect to find, on the higher levels, chalk or limestone of some sort, and, as he descended into the lower plains, that the rocks would gradually lose their calcareous character, passing from chalk to argillaceous limestone, from that to a calciferous slate, and finally into slate containing no lime whatever.

There is every reason to believe that the fine red clay accumulation is but incipient slate rock.

If, then, the great bulk of these rocks be removed from the category of mechanically formed, into that of chemically formed, or of organic, rocks, it will appear that geologists have been in the habit of underestimating the importance of organic processes as geological agents. We will no longer be able to affirm with confidence, of a single grain of the commonest materials found on the earth's surface, that it has not at one time or other been associated with the manifestation of those mysterious forces which we call living. Our globe therefore resolves itself into a great charnel house or mausoleum. Man has been called a plagiarism from oxen and sheep; but his house, whether it be of mud or of marble, is equally a plagiarism from the deserted dwellings of the invertebrata.

The tendency of modern geology has been to break down the well marked divisions into which the older geologists were wont to parcel out past time. The old notion, which in some measure still clings to the terms Devonian, carboniferous, cretaceous, etc., was that of a distinct period in the history of the earth. Each of these epochs was conceived to have begun and closed before the succeeding era began. In this way the world was believed to have passed through so many stages, in each of which only rocks belonging to that particular formation were deposited anywhere on the earth's surface. Thus, all the rocks of the gneiss were thought to have been formed before the lowest of the Cambrian began to be laid down; similarly with the succeeding silurian and Devonian systems. Now, however, these terms are used without reference to time, and we think of systems, widely separated according to the old method, being formed simulneously. The chalk age was formerly supposed to have come to an end at a period long prior to man's appearance on the earth, but the researches of Carpenter, Thomson, Huxley, and others have established the "continuity of the chalk," and shown that a fauna, very similar to, if not identical with, that of the chalk, inhabits the Atlantic at the present day. The discovery of this red clay seems to point to the continuity of those ages when slate rocks were supposed to have attained a maximum, that is,of the Cambrian and silurian formations.

Chalk deposits and coral reefs are, by a process of metamorphosis, converted into crystalline limestone, and by the action of sea water even into dolomite. Granite and other so called primitive rocks have been shown to be in many cases only metamorphosed sedimentary strata, so that we are unable to say in what particular line the recurring cycles of geological operations began; nor, on this account, can we assert, except in the case of species which have become extinct, that the fauna of any preceding differed from that of the present age.

When this red clay comes to be slate, the only traces of life it can exhibit will be derived from silica-secreting organisms of a low type, like those doubtful appearances in older slate rocks which have been described as fossils. It is therefore altogether unwarrantable to regard this low type as the sole, or even prevailing, form of life during the time when these rocks were formed; nevertheless, there have not been wanting supporters of this view.

For aught, then, that geology can say, while the oldest rocks of Britain were being laid down in 3,000 fathoms of water, far away silurian man may have been cultivating vines on the fertile slopes that flanked the volcanoes of the period.—*A. S. Wilson.*

Correspondence.

Hardening and Tempering Tools.

To the Editor of the Scientific American:

It has been with no inconsiderable degree of interest that I have read Mr. Joshua Rose's several papers, published in your recent issues, treating on machinists' tools and their treatment in forging and tempering for specific purposes. He prefaces his remarks on tool hardening, in his fourth paper (in your issue of July 11), with the remark: "The degree to which a tool may be hardened is dependent in a great measure on its shape;" and he states what particular shapes or forms of tool require special treatment, in forging and tempering, to render them of maximum utility. With very great clearness, he sets forth the practice of lowering the degrees of hardness by watching the hue assumed by the polished surface of the tool that had been immersed in water at a "moderate red" after it had been reheated, or allowing that part of the tool that had not been immersed to impart its heat to the part that had been immersed to "draw the temper," or obtain the required degree of hardness or tenacity: while in other specific cases, he states that tools require to be "as hard as fire and water can make them." His several papers have evinced considerable practical knowledge, and he evidently writes his experience with great perspicacity.

I would not now have obtruded upon you had I not noticed, in your issue antedated August 1, a communication from Mr. John T. Hawkins, in which he makes an extract from one of a series of lectures he had delivered to the engineer class at the Annapolis Naval Academy, in 1868. "It is safe," he had stated in this lecture, "to say that a cutting tool cannot be too hard for any purpose whatever, so long as the edge will not crumble or break up. "Mr. Rose, in his paper, says: "It is undoubtedly advantageous to make the tool as hard as it can be made, so long as it will bear the strain of the cut," and enumerates the several steels (with the makers' names) capable of such treatment. Mr. Rose, treating his subject in quite a masterly manner, states that tools for particular kinds of work require to be "as hard as fire and water can make them," while the temper of others, for other special service, should be "lowered in temper" (hardness) "to a light straw color, which leaves them stronger than they would be if hardened right out," that is, changing the condition of the tool by sudden immersion and allowing the tool to remain in the fluid until cold or of a temperature equal to that of the fluid, for he also states (and correctly) that the "chill should be taken off the water." Mr. Rose is evidently giving the result of his experience, for the benefit of those who have not had the varied experience he evinces in his papers on tools and their treatment under the elements of fire and water. His language is plain; he makes the object of his investigation speak, as it were, in its own language.

Steel or iron, immersed in water at a "moderate red" or white heat, hardens. In this Mr. Rose and Mr. Hawkins are agreed; but Mr. Hawkins states that Mr. Rose makes his "greatest oversight" in the final operation of drawing the temper, and adds that to "give simply a certain color to a tool is the least of what is required to be known or observed." By whatever chemical action or cause the various hues appear, that guide the operative in tempering tools, it is doubtless a natural law or sequence, and, as such, is subject to conditions. The different hues will appear, faster or slower, which alike are subject to conditions of degrees of temperature at which they commence to evolve, rapidly at high, and gradually at low, temperatures, to produce what Mr. Hawkins calls "films of oxide."

I have failed to see where Mr. Rose has made his greatest oversight. Mr. Rose states: "While he who has been accustomed to the use of tools properly forged and hardened right out, upon entering another shop where the tools are overheated in forging and underhardened to compensate for it, finding he cannot," etc. Mr. Hawkins says: "If a tool be dipped at the lowest temperature at which it will harden at all, it will be harder when ready for use than if dipped at any higher temperature, if required to be drawn at all."

Here the gentlemen in question evidently mean the same thing, namely, that low temperatures are best for tempering tools. Each seems to regard the color evolved during the process of tempering tools as important. Still while Mr. Rose speaks of positive colors, Mr. Hawkins treats of conditions. Mr. Rose treats things as they are and as they appear to every observer, and advises the easiest means to the end. Mr. Hawkins writes of films of oxide and conditions necessary to produce them, as if they were negative or absent. Mr. Rose, on the contrary, mentions them as ever present and attendant upon the operative for him to avail himself of.

Many tool dressers there are who regard the hues evolved in the process of drawing the temper as the steel maker or iron maker does those evolved or emitted by the spectroscope, while watching to shut off the blast at the proper instant of time; and it seems that the hues evolved in tempering tools is so regarded by Mr. Rose. The hues will appear sooner in a thin piece of metal having the same temperature as that of a thick one; but these differ in hardness or tenacity if immersed at the same instant of time. A thin piece of metal will harden more thoroughly than a thick one and will differ in degrees of hardness. I hope that you may deem my criticism worthy of a place in your paper.

Trenton, N. Y. JUAN PATTISON, C. E.

Steam Cars.

To the Editor of the Scientific American:

Some months ago I referred to a short line of three feet gage railway which was then being put in operation between Worcester and Shrewsbury; and since that time I have watched with much interest the working of the steam cars which have been running on the line. On account of the heavy grades, one hundred and sixty feet to the mile, it has been a pretty severe trial for these machines, and they have stood the test remarkably well; but I think that a slight modification in their construction would render them far more durable and efficient. It was demonstrated practically and in a most thorough manner, seventy years ago, that the steam engine was applicable to the hardest kind of locomotive work. Where Oliver Evans propelled his mud scow, weighing sixteen or eighteen tuns, over the sand, from his shops along the bank of the Schuylkill, a distance of some two miles, by the power of its own engine—which was about five horse—it was sufficient proof that the thing was quite feasible.

During these seventy years since that exploit of Evans, the thing has been verified in every possible way; locomotives have been constructed in every conceivable form: with boilers vertical, horizontal, and both combined; with one, two, three, and four cylinders; with cylinders vertical, horizontal, and slanting, with cylinders placed inside as well as outside of the boiler, with cylinders of unequal size, with cranks between and outside of the drivers, etc. And the result of all this long and costly experience is our present locomotive, an ideal at once of simplicity, symmetry, beauty, and efficiency; and it certainly seems that a model which is the outgrowth of such an ordeal, and which has proved so so eminently satisfactory and efficient for the whole of the immense railroad work of the world, ought to be more of a guide for those who are engaged in making steam cars and traction engines for whatever purpose of locomotion.

The great efficiency of our present locomotive is doubtless chiefly due to its boiler. It seems to be the only plan which possesses so perfectly all of the qualities needed for locomotive work. It is simple, compact, accessible for repairs, has vast generating power; all of its parts exposed to intense heat are deeply covered with water, and, of course, it may be constructed of any desired strength. Its center of gravity is low, and this part is an important item in the construction of all locomotive engines.

I believe that if makers of steam cars or traction engines of any kind would adopt precisely this type of boiler for the foundation of their machines, and then make and correct their running gear in as thorough and symmetrical a manner as is the practice of our best locomotive builders, we should see far better results in this line of engineering. The common upright boiler, though an excellent boiler for certain uses, is unsuitable for first class locomotives. If made short, the tops of the tubes are too much affected by the intense heat required to maintain the 120 or 150 lbs. to the square inch, which is necessary to do the work; if made long, the center of gravity is too high; if made with an annular steam chamber above the top of the tubes of sufficient capacity, this also brings the center of gravity too high, and also renders the top of the tubes unhandy for repairs. In either case the boiler lacks generating power.

I have much confidence, as a matter of economy, in the idea of making the cylinders of locomotives of unequal capacity, say in the proportion of three or four to one, the small cylinder exhausting into the large one through a superheater, but so arranged that direct steam may be used in both cylinders whenever an exigency requires. Our present locomotives might be easily arranged in this way without affecting their style at all. In passenger and express work especially, considerable economy would doubtless result from this change. F. G. WOODWARD.

The Zodiacal Light.

To the Editor of the Scientific American:

The erroneous assertions made by one of your correspondents (page 371 of the number for June 13), in regard to the zodiacal light, ought not to remain uncorrected. He says: "The zodiacal light is not on two sides of the sun, neither is it all around the sun; but, on the contrary, it is ever on one side of the sun only, his hinder side, if you will," etc. This error proceeds from the fact that he judges only from its appearance in our latitude, where we see this phenomenon distinctly only in April and May after sundown, and in October and November before sunrise. If this were the case over the whole earth, his assertion might have some foundation; but as in the southern hemisphere it is not visible at the periods stated, but only distinctly seen in April and May before sunrise, and in October and November after sunset (exactly at the very times that it is invisible in our northern hemisphere), the assertion that it is only at one side of the sun falls to the ground.

Between the tropics this phenomenon shows itself the whole year round, every morning and evening, with great splendor. Humboldt states, in his "Cosmos," that in the highlands of South America he watched it morning and evening, and observed that it sometimes varied in brilliancy, and often equaled in luminosity the brightest spots of the Milky Way; sometimes it was weaker, but it was always there, whether the observer was on land, or on the mountain tops, or at sea, on shipboard.

Some account of the latest observations between the tropics were furnished by Chaplain Jones, of the United States Navy, who observed it in the years 1856–57 from the elevated equatorial region in which the city of Quito is situated. His observations verified the fact that the light is entirely confined to the region of the zodiac; that it was very strong in the central band and broadly diffused at the sides, where it it gradually faded away; however, a boundary line between the stronger and weaker portions was quite distinct.

He not only saw the light every night, but at midnight at both sides of the horizon, in the east and in the west at the same time; and during favorably clear nights, it extended as a broad, luminous arch over the zenith, entirely from one horizon to the other, having a pale white luster, and a breadth of about 30°.

In high northern and southern latitudes it is never visible, as the ecliptic is too much inclined to the horizon; in the temperate zone, it is only visible in those periods of the year in which the zodiac is as nearly perpendicular to the horizon as possible. In the northern hemisphere, this is the case in April and May, at evening, and in October and November, at morning; and in the southern hemisphere, the cases are reversed. At other seasons, our atmosphere obstructs the diffused light from reaching our eyes, as it is too far from the zenith, and this is the sole reason that we do not see it always, as is the case between the tropics. In December, however, it may be faintly observed, both morning and evening, even in the latitude of New Jersey.

The discovery of Professor Wright that it is caused by the reflection of solar light from solid meteoric material, combined with the above observations, proves that this zone of meteors extends beyond the earth's orbit, and that the earth moves among them. It is certain that they revolve around the sun, so as to counterbalance solar gravitation, and it is highly probable that, in regard to their orbits and velocity, they are subject to Kepler's laws. In the course of ages, their mutual gravitation causes some of them to combine, and so their number must diminish; while also, from time to time, the earth, Mars, Venus, and Mercury appropriate others of them. In regard to our earth, at least, we know that the fall of meteorites is not a very uncommon occurrence. It is probable that our whole planetary system has been made up in this way, and that the different belts of meteors, the zodiacal light, the asteroids, etc, constitute what there is now left of the material from which sun and planets were primitively formed by the action of universal gravitation.

New York city. P. H. VANDER WEYDE.

The Business Outlook.

In a time of drouth, it is safe to predict rain, because we know that in the economy of Nature there is an inevitable law of reaction; and in a period of business depression, we known that it cannot always last, because the elements exist which are certain to bring about renewed activity. These elements are manifest and visible all around us. The great staple products of grain and cotton, to say nothing of other crops which promise an abundant yield, will in a few weeks add untold millions to the wealth of the nation. There is midsummer stagnation now, and dullness prevails in all departments of trade and manufacture; but is it rational to suppose that the crops now maturing are to be gathered in to rot in warehouses, that exchanges and consumption will cease, the reduced stocks of general merchandize remain unreplenished, and the accumulation of unemployed capital wait in vain for profitable investment, and all because a few railroads have been built on speculation, and have come to grief for the lack of capital and earnings to meet their obligations? We admit there is a present want of confidence in railroad securities which ties up capital and keeps it in abeyance; but it is a significant sign that, notwithstanding the Wisconsin imbroglio and the record of embarrassment and bankruptcy of the past eight months, choice securities are more in demand and command better prices than before the panic. The movement of the crops which must soon begin will give employment to capital and also to the roads; confidence will gradually be restored, the machinery of trade set in motion, and the activity thus inaugurated will be legitimate and lasting. The crippled roads will gradually get upon a better basis; and with the natural development and increase of traffic, there is no reason to doubt that existing lines will be improved, and new ones constructed wherever they are really required. If this is a rose colored view of the situation, not justified by present appearances and indications, then the history of previous revulsions in trade and business is no criterion by which to judge, and any speculation in regard to the future is of no avail.—*National Car Builder*