NIKOLA TESLA.

ERVIAN poetry has so distinct a charm that Goethe is said to have learned the musical tongue in which it is written rather than lose any of its native beauty. History does not record, however, any similar instance in which the Servian language, though it be that of Boskovich, expounder of the atomic theory, has been studied for the sake of the scientific secrets that might lurk therein. The vivid imagination and ready fancy of the people have been literary in their manifestation and fruit. A great Slav orator has publicly reproached his one hundred and twenty million fellows in Eastern Europe with their utter inability to invent even a mouse-trap. They were all mere barren idealists. If this were true, to equalize matters, we might perhaps barter without loss some score of ordinary American patentees for a single singer of Illyrian love-songs. But racial conditions are hardly to be offset on any terms that do not leave genius its freedom, and once in a while Nature herself rights things by producing a man whose transcendent merit compensates his nation for the very defects to which it has long been sensitive. It does not follow that such a man shall remain in a confessedly unfavorable environment. Genius is its own passport, and has always been ready to change habitats until the natural one is found. Thus it is, perchance, that while some of our artists are impelled to set up their easels in Paris or Rome, many Europeans of mark in the fields of science and research are no less apt to adopt our nationality, of free choice. They are, indeed, Americans born in exile, and seek this country instinctively as their home, needing in reality no papers of naturalization. It was thus that we welcomed Agassiz, Ericsson, and Graham Bell. In like manner Nikola Tesla, the young Servian inventor with whose work a new age in electricity is beginning, now dwells among us in New York.

Mr. Tesla's career not only touches the two extremes of European civilization, east and west, in a very interesting way, but suggests an inquiry into the essential likeness between poet and inventor. He comes of an old Servian family whose members for centuries have kept watch and ward along the Turkish frontier, and whose blood was freely shed that our western vanguard might gain time for its advance upon these shores. Yet, remote as such people and conditions are to us, it is with apparatus based on ideas and principles originating among them that the energy from Niagara Falls is to be widely distributed by electricity, in the various forms of light, heat, and power. This, in itself, would seem enough to confer fame, but Mr. Tesla has done, and will do, much else. Could he be tamed to habits of moderation in work, it would be difficult to set limit to the solutions he might give us, through ripening years, of many deep problems; but when a man springs from a people who have a hundred words for knife and only one for bread, it is a little unreasonable to urge him to be careful even of his own life. Thirty-six years make a brief span, but when an inventor believes that creative fertility is restricted to the term of youth, it is no wonder that night and day witness his anxious activity, as of a relentless volcano, and that ideas well up like hot lava — till the crater be suddenly exhausted and hushed.

A Slav of the Slavs, with racial characteristics strongly stamped in look, speech, and action, Mr. Tesla is a notable exemplification of the outcropping in unwonted form of tendencies suppressed. I have never heard him speak of a picture or a piece of music, but his numerous inventions, and the noble lectures that embody his famous investigations with currents of high frequency and high potential, betray the poetic temperament throughout. One would expect the line separating fact from theory to fade at the altitudes of thought to which his later speculations reach; but this lithe, spare mountaineer is accustomed to the thin, dry air, and neither loses sharpness of sight nor breathes painfully. Has the Servian poet become inventor, or is the inventor a poet? Mr. Tesla has been held a visionary, deceived by the flash of casual shooting stars; but the growing conviction of his professional brethren is that because he saw farther he saw first the low lights flickering on tangible new continents of science. The perceptive and imaginative qualities of the mind are not often equally marked in the same man of genius. Overplus of imagination may argue dimness of perception; an ability to dream dreams may imply a want of skill in improving reapers. Now and then the two elements combine in the creative poet of epic and drama; occasionally they give us the prolific inventor like Tesla.

Jules Breton has spoken of the history of his life as being at the same time the genesis of his art. This is true of Nikola Tesla's evolution. His bent toward invention we may surely trace to his mother, who, as the wife of an eloquent

clergyman in the Greek Church, made looms and churns for a pastoral household while her husband preached. Tesla's electrical work started when, as a boy in the Polytechnic School at Gratz, he first saw a direct-current Gramme machine, and was told that the commutator was a vital and necessary feature in all such apparatus. His intuitive judgment or latent spirit of invention at once challenged the statement of his instructor, and that moment began the process of reasoning and experiment which led him to his discovery of the rotating magnetic field, and to the practical polyphase motors, in which the commutator and brushes, fruitful and endless source of trouble, are absolutely done away with. These perfected inventions did not come at once; they never do. The conditions that surrounded this youth in the airy fastnesses of the Dinaric Alps all made against the hopes he nursed of becoming an electrician; and not the least impediment was the fond wish of his parents at Smiljan Lika that he should maintain the priestly tradition, and benefit by the preferment likely to come through his uncle, now Metropolitan in Bosnia. But Tesla felt himself destined to serve at other altars than those of his ancient faith, with other means of approach to the invisible and unknown. He persevered in mathematical and mechanical studies, mastered incidentally half a dozen languages, and at last became an assistant in the Government Telegraph Engineering Department at Buda-Pest. His salary was small enough to please those who hold that the best endowment of genius is poverty, and he would make no appeals to his widowed mother for help. Experimenting, of course, went on all the time; at this juncture it was on telephony that he wasted his meager substance in riotous invention. Desirous of going to a fête with some friends, and anxious not to spend on clothes the money that might buy magnets and batteries, the brilliant idea occurred to him to turn his only pair of trousers inside out and to disport in them on the morrow as new. He sat up all night tailoring, but the fête came and went before he could reappear in public. This episode is quite in keeping with his boyish efforts to fly from the steep roof of the house at Smiljan, using an old umbrella as aërostat; or with the peculiar tests, stopped by the family doctor before the results could be determined, as to how long he could suspend the beating of his heart by will power.

Naturally enough for a young inventor seeking larger opportunity, Tesla soon drifted westward from Buda-Pest. He made his way to Paris, where he quickly secured employment in electric lighting, then a new art, and encountered an observant associate of Mr. Edison. Almost before he knew it, he was on his glad voyage across the Atlantic to work in one of the Edison shops, and to enter upon a new stage of development. He had profound faith in the value of the principles first meditated in the silence of the sterile mountains that border the Adriatic, and he knew that in a country where every new invention in electricity has its chance, his turn would come also, for he now had demonstrated his theories in actual apparatus.

If anything were needed to confirm Mr. Tesla in his hopes and enthusiasm, it would have been the close relation that he was thus thrown into with the robust, compelling genius who has created so many new things in electricity. Emerson has said that steam is half an Englishman; may we not, in view of what such men as Edison have done, add that electricity is half an American? The fiery zeal with which this young recruit flung himself on the most exacting tasks matched that of his chief. It went the length of a daily breakfast of Welsh rabbit, for weeks Mr. Tesla accepting as true, in spite of protesting stomach, the jocular suggestion that it was thus that his hero fortified himself successfully for renewed effort after their long vigils of toil. Mr. Edison, like most other people, had some difficulty in finding anywhere within the pale of civilization, as marked by the boundaries of maps, the isolated region of Mr. Tesla's birth, and once inquired seriously of his neophyte whether he had ever tasted human flesh. It was inevitable that a really delightful intimacy and apprenticeship should end. Even the most cometic genius has its orbit, and these two men are singularly representative of different kinds of training, different methods, and different aims. Mr. Tesla must needs draw apart; and stimulated by this powerful spirit, he went on his own way for his own work's sake.

Of late years a sharp controversy has raged in the electrical field as to the respective advantages of the continuous and the alternating current for light and power. In bitterness and frequent descent to personalities it has resembled the polemics of the old metaphysical schoolmen, and uninstructed, plain folk have mildly wondered whether it was really worth while to indulge in such terrible threatenings and slaughter over purely speculative topics. There is, however, a very practical aspect to the discussion, and from the first Mr. Tesla has been an advocate of the alternating current, not because he loved the direct current less, but because he knew that with the alternating he could achieve results otherwise impossible, especially in power transmission. Furthermore, all direct-current generators and motors have required commutators and brushes, but Mr. Tesla, who has himself perfected many inventions based on direct currents, has shown that with the ap-

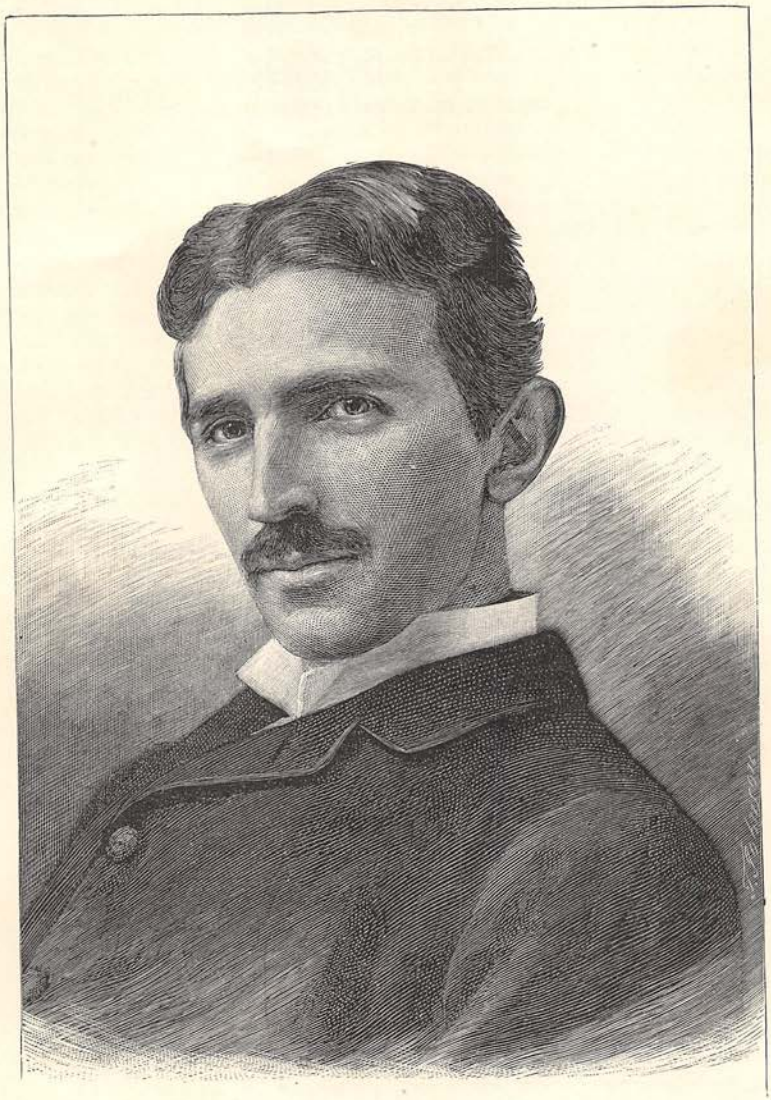
plication of the rotating-field principle these elements of complication and restriction were no longer needed. This utilization of polyphase currents was a most distinct advance, made a deep imprint on the electric arts, and has been duly signalized. In America the invention found immediate sale. From Italy came an insistent cry of priority, reminding one of the "anticipations" that have clustered thick around the telegraph, the telephone, and the incandescent lamp. In Germany, with money raised by popular and imperial subscription, apparatus on the polyphase principle was built by which large powers were transmitted electrically more than a hundred miles from Neckar-on-the Rhine to Frankfort-on-the-Main; and now by equivalent agency Niagara is to drive the wheels of Buffalo and beyond.

So thoroughly has Mr. Tesla worked out his discovery of the rotating magnetic field, or "resultant attraction," that the record of his inventions contains no fewer than twenty-four chapters on varying forms of his polyphase-current apparatus and arrangements of circuit. But ever pursuing new researches, Mr. Tesla, after the enunciation of these fundamental ideas, next brought to notice his series of even more interesting investigations on several novel groups of phenomena produced with currents of high potential and high frequency. To familiarize the American public with some of his results, he lectured upon them at Columbia College, before the American Institute of Electrical Engineers, in May, 1891. The year following, with riper results to publish, and by special invitation, he lectured twice in England, appearing before the Institution of Electrical Engineers, a distinguished scientific body of which Professor Crookes was then president, and, later, at the Royal Institution, where the immortal Faraday lived and labored. From England he was called to France to repeat his demonstrations before the Société Internationale des Electriciens and the Société Française de Physique. In Germany he received the greetings of Hertz and Von Helmholtz, and from his own country came the Order of Saint Sava, conferred by the king. Since his return to this country he has lectured before the Franklin Institute at Philadelphia and the National Electric Light Association at St. Louis. But he has an intense dislike to the platform, and has returned to his laboratory with a remorseful sense of neglected work from which long months of abandonment to unremitting research will not free him.

I can only outline the vast range of the researches that these lectures, and the apparatus connected with the demonstrations, cover. Broadly stated, Mr. Tesla has advanced the opinion, and sustained it by brilliant experiments of startling beauty and grandeur, that light and heat are produced by electrostatic forces acting between charged molecules or atoms. Perfecting a generator that would give him currents of several thousand alternations per second, and inventing his disruptive discharge coil, he has created electrostatic conditions that have already modified not a few of the accepted notions about electricity. It has been supposed that ordinary currents of one or two thousand volts' potential would surely kill, but Mr. Tesla has been seen receiving through his hands currents at a potential of more than 200,000 volts, vibrating a million times per second, and manifesting themselves in dazzling streams of light. This is not a mere *tour de force*, but illustrates the principle that while currents of lower frequency destroy life, these are harmless. After such a striking test, which, by the way, no one has displayed a hurried inclination to repeat, Mr. Tesla's body and clothing have continued for some time to emit fine glimmers or halos of splintered light. In fact, an actual flame is produced by this agitation of electrostatically charged molecules, and the curious spectacle can be seen of puissant, white, ethereal flames, that do not consume anything, bursting from the ends of an induction coil as though it were the bush on holy ground. With such vibrations as can be maintained by a potential of 3,000,000 volts, Mr. Tesla expects some day to envelop himself in a complete sheet of lambent fire that will leave him quite uninjured. Such currents as he now uses would, he says, keep a naked man warm at the North Pole, and their use in therapeutics is but one of the practical possibilities that has been taken up.

Utilizing similar currents and mechanism, Mr. Tesla has demonstrated the fact that electric lamps and motors can not only be made to operate on one wire, instead of using a second wire on the ground to complete the circuit, but that we can operate them even by omitting the circuit. Our Subway Boards are to find their wires and occupations gone. Electric vibrations set up at any point of the earth may by resonance at any other spot serve for the transmission of either intelligence or power. With these impulses or wave discharges, Mr. Tesla also opens up an entirely new field of electric lighting. His lamps have no filaments as ordinarily known, but contain a straight fiber, a refractory button, or nothing but a gas. Tubes or bulbs of this kind, in which the imprisoned ether or air beats the crystal walls, when carried into the area or room through which these unsuspected currents are silently vibrating, burst into sudden light. If coated inwardly with phosphorescent substances, they glow in all the splendors of the sunset and the aurora.

These are only a scant handful of ideas and



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discoveries from the rich mint of Mr. Tesla's laboratory, where alone, secluded, intimates or assistants shut out, he reasons from cause to effect; and with severe, patient diligence not only elaborates his theories, but tries them by the rack and thumbscrew of experiment. He is of all men most dissatisfied with things as they are in his own field of work. Recently, the high-frequency generators with which he has done so much of this advanced work have been laid aside in discontent for an oscillator, which he thinks may not only replace the steam-engine with its ponderous fly-wheels and governors, but embodies the simplest possible form of efficient mechanical generator of electricity. He may be wrong, but misdirection will only suggest new avenues to the goal.

Mr. Tesla has often been urged to assume domestic ties, settle down, and till some corner of the new domain. But shall he farm or explore? Soon enough the proprietary fences will be set up; soon enough will the dusty, beaten highway, dotted with milestones and finger-posts, run straight ahead. If we would, we cannot leash the pioneers whose yearnings are for inner Nature, whose sense is keenest to her faint voices and odors, the quest of which lures onward through the trackless woods.

Thomas Commerford Martin.