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Also by Isaac Asimov

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Foundation and Empire
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The Currents of Space
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The Caves of Steel
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Nebula Award Stories 8 (ed.)
The Stars in Their Courses (non-fiction)
The Left Hand of the Electron (non-fiction)
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Isaac Asimov

I, Robot

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To John W. Campbell Jr. who godfathered the robots

The story entitled 'Robbie' was first published as 'Strange Playfellow' in *Super Science Stories*, copyright 1940 by Fictioneers, Inc. The following stories from *Astounding Science Fiction*, 'Reason', 'Liar!', 'Runaround', 'Catch That Rabbit', 'Escape!', 'Evidence', 'Little Lost Robot', 'The Evitable Conflict', are respectively copyright, 1941, 1941, 1942, 1944, 1945, 1946, 1947, 1950 by Street and Smith Publications, Inc.

'And when is that?'

Dr. Calvin was at the door. She said quietly, 'When the human to be struck is merely another robot.'

She smiled broadly, her thin face glowing. 'Good-by, Mr. Byerley. I hope to vote for you five years from now - for co-ordinator.'

Stephen Byerley chuckled. 'I must reply that that is a somewhat farfetched idea.'

The door closed behind her.

I stared at her with a sort of horror, 'Is that true?'

'All of it,' she said.

'And the great Byerley was simply a robot.'

'Oh, there's no way of ever finding out. I think he was. But when he decided to die, he had himself atomized, so that there will never be any legal proof. —Besides, what difference would it make?'

'Well—'

'You share a prejudice against robots which is quite un-reasoning. He was a very good Mayor; five years later he did become Regional Co-ordinator. And when the Regions of Earth formed their Federation in 2044, he became the first World Co-ordinator. By that time it was the Machines that were running the world anyway.'

'Yes, but—'

'No buts! The Machines are robots, and they are running the world. It was five years ago that I found out all the truth. It was 2052; Byerley was completing his second term as World Co-ordinator—'

THE EVITABLE CONFLICT

THE Co-ordinator, in his private study, had that medieval curiosity, a fireplace. To be sure, the medieval man might not have recognized it as such, since it had no functional significance. The quiet, licking flame lay in an insulated recess behind clear quartz.

The logs were ignited at long distance through a trifling diversion of the energy beam that fed the public buildings of the city. The same button that controlled the ignition first dumped the ashes of the previous fire, and allowed for the entrance of fresh wood. —It was a thoroughly domesticated fireplace, you see.

But the fire itself was real. It was wired for sound, so that you could hear the crackle and, of course, you could watch it leap in the air stream that fed it.

The Co-ordinator's ruddy glass reflected, in miniature, the discreet gamboling of the flame, and, in even further miniature, it was reflected in each of his brooding pupils.

—And in the frosty pupils of his guest, Dr. Susan Calvin of U.S. Robots & Mechanical Men Corporation.

The Co-ordinator said, 'I did not ask you here entirely for social purposes, Susan.'

'I did not think you did, Stephen,' she replied.

'—And yet I don't quite know how to phrase my problem. On the one hand, it can be nothing at all. On the other, it can mean the end of humanity.'

'I have come across so many problems, Stephen, that presented the same alternative. I think all problems do.'

'Really? Then judge this— World Steel reports an overproduction of twenty thousand long tons. The Mexican Canal is two months behind schedule. The mercury mines at Almaden have experienced a production deficiency since last spring, while the Hydroponics plant at Tientsin has been

laying men off. These items happen to come to mind at the moment. There is more of the same sort.'

'Are these things serious? I'm not economist enough to trace the fearful consequences of such things.'

'In themselves, they are not serious. Mining experts can be sent to Almaden, if the situation were to get worse. Hydroponics engineers can be used in Java or in Ceylon, if there are too many at Tientsin. Twenty thousand long tons of steel won't fill more than a few days of world demand, and the opening of the Mexican Canal two months later than the planned date is of little moment. It's the Machines that worry me; - I've spoken to your Director of Research about them already.'

'To Vincent Silver? —He hasn't mentioned anything about it to me.'

'I asked him to speak to no one. Apparently, he hasn't.'

'And what did he tell you?'

'Let me put that item in its proper place. I want to talk about the Machines first. And I want to talk about them to you, because you're the only one in the world who understands robots well enough to help me now. —May I grow philosophical?'

'For this evening, Stephen, you may talk how you please and of what you please, provided you tell me first what you intend to prove.'

'That such small unbalances in the perfection of our system of supply and demand, as I have mentioned, may be the first step towards the final war.'

'Hmp. Proceed.'

Susan Calvin did not allow herself to relax, despite the designed comfort of the chair she sat in. Her cold, thin-lipped face and her flat, even voice were becoming accentuated with the years. And although Stephen Byerley was one man she could like and trust, she was almost seventy and the cultivated habits of a lifetime are not easily broken.

'Every period of human development, Susan,' said the Coordinator, 'has had its own particular type of human conflict - its own variety of problem that, apparently, could be settled only by force. And each time, frustratingly enough, force never really settled the problem. Instead, it persisted through a series of conflicts, then vanished of itself - what's the expression, - ah, yes "not with a bang, but a whimper", as the

economic and social environment changed. And then, new problems, and a new series of wars. —Apparently endlessly cyclic.

'Consider relatively modern times. There were the series of dynastic wars in the sixteenth to eighteenth centuries, when the most important question in Europe was whether the houses of Hapsburg or Valois-Bourbon were to rule the continent. It was one of those "inevitable conflicts", since Europe could obviously not exist half one and half the other.

'Except that it did, and no war ever wiped out the one and established the other, until the rise of a new social atmosphere in France in 1789 crumbled first the Bourbons and, eventually, the Hapsburgs down the dusty chute to history's incinerator.

'And in those same centuries there were the more barbarous religious wars, which revolved about the important question of whether Europe was to be Catholic or Protestant. Half and half she could not be. It was "inevitable" that the sword decide. —Except that it didn't. In England, a new industrialism was growing, and on the continent, a new nationalism. Half and half Europe remains to this day and no one cares much.

'In the nineteenth and twentieth centuries, there was a cycle of nationalist-imperialist wars, when the most important question in the world was which portions of Europe would control the economic resources and consuming capacity of which portions of non-Europe. All non-Europe obviously could not exist part English and part French and part German and so on. —Until the forces of nationalism spread sufficiently, so that non-Europe ended what all the wars could not, and decided it could exist quite comfortably *all* non-European.

'And so we have a pattern—'

'Yes, Stephen, you make it plain,' said Susan Calvin. 'These are not very profound observations.'

'No. —But then, it is the obvious which is so difficult to see most of the time. People say "It's as plain as the nose on your face." But how much of the nose on your face can you see, unless someone holds a mirror up to you? In the twentieth century, Susan, we started a new cycle of wars - what shall I call them? Ideological wars? The emotions of religion applied to economic systems, rather than to extra-natural ones?'

Again the wars were "inevitable" and this time there were atomic weapons, so that mankind could no longer live through its torment to the inevitable wasting away of inevitability. —And positronic robots came.

'They came in time, and, with it and alongside it, inter-planetary travel. —So that it no longer seemed so important whether the world was Adam Smith or Karl Marx. Neither made very much sense under the new circumstances. Both had to adapt and they ended in almost the same place.'

'A *deus ex machina*, then, in a double sense,' said Dr. Calvin, dryly.

The Co-ordinator smiled gently, 'I have never heard you pun before, Susan, but you are correct. And yet there was another danger. The ending of every other problem had merely given birth to another. Our new world wide robot economy may develop its own problems, and for that reason we have the Machines. The Earth's economy is stable, and will *remain* stable, because it is based upon the decisions of calculating machines that have the good of humanity at heart through the overwhelming force of the First Law of Robotics.'

Stephen Byerley continued, 'And although the Machines are nothing but the vastest conglomeration of calculating circuits ever invented, they are still robots within the meaning of the First Law, and so our Earth-wide economy is in accord with the best interests of Man. The population of Earth knows that there will be no unemployment, no overproduction or shortages. Waste and famine are words in history books. And so the question of ownership of the means of production becomes obsolescent. Whoever owned them (if such a phrase has meaning), a man, a group, a nation, or all mankind, they could be utilized only as the Machines directed. —Not because men were forced to but because it was the wisest course and men knew it.

'It puts an end to war — not only to the last cycle of wars, but to the next and to all of them. Unless—'

A long pause, and Dr. Calvin encouraged him by repetition. 'Unless—'

The fire crouched and skittered along a log, then popped up.

'Unless,' said the Co-ordinator, 'the Machines don't fulfill their function.'

'I see. And that is where those trifling maladjustments come in which you mentioned awhile ago — steel, hydroponics and so on.'

'Exactly. Those errors should not be. Dr. Silver tells me they *cannot* be.'

'Does he deny the facts? How unusual!'

'No, he admits the facts, of course. I do him an injustice. What he denies is that any error in the machine is responsible for the so-called (his phrase) errors in the answers. He claims that the Machines are self-correcting and that it would violate the fundamental laws of nature for an error to exist in the circuits of relays. And so I said—'

'And you said, "Have your boys check them and make sure, anyway."'

'Susan, you read my mind. It was what I said, and he said he couldn't.'

'Too busy?'

'No, he said that no human could. He was frank about it. He told me, and I hope I understand him properly, that the Machines are a gigantic extrapolation. Thus— A team of mathematicians work several years calculating a positronic brain equipped to do certain similar acts of calculation. Using this brain they make further calculations to create a still more complicated brain, which they use again to make one still more complicated and so on. According to Silver, what we call the Machines are the result of ten such steps.'

'Ye-es, that sounds familiar. Fortunately, I'm not a mathematician. —Poor Vincent. He is a young man. The Directors before him, Alfred Lanning and Peter Bogert, are dead, and they had no such problems. Nor had I. Perhaps roboticists as a whole should now die, since we can no longer understand our own creations.'

'Apparently not. The Machines are not super-brains in Sunday supplement sense, — although they are so pictured in the Sunday supplements. It is merely that in their own particular province of collecting and analyzing a nearly infinite number of data and relationships thereof, in nearly infinitesimal time, they have progressed beyond the possibility of detailed human control.

'And then I tried something else. I actually asked the Machine. In the strictest secrecy, we fed it the original data

involved in the steel decision, its own answer, and the actual developments since — the overproduction, that is — and asked for an explanation of the discrepancy.'

'Good, and what was its answer?'

'I can quote you that word for word: "The matter admits of no explanation."'

'And how did Vincent interpret that?'

'In two ways. Either we had not given the Machine enough data to allow a definite answer, which was unlikely. Dr. Silver admitted that. —Or else, it was impossible for the Machine to admit that it could give any answer to data which implied that it could harm a human being. This, naturally, is implied by the First Law. And then Dr. Silver recommended that I see you.'

Susan Calvin looked very tired, 'I'm old, Stephen. When Peter Bogert died, they wanted to make me Director of Research and I refused. I wasn't young then, either, and I did not wish the responsibility. They let young Silver have it and that satisfied me; but what good is it, if I am dragged into such messes.

'Stephen, let me state my position. My researches do indeed involve the interpretation of robot behavior in the light of the Three Laws of Robotics. Here, now, we have these incredible calculating machines. They are positronic robots and therefore obey the Laws of Robotics. But they lack personality; that is, their functions are extremely limited. —Must be, since they are so specialized. Therefore, there is very little room for the interplay of the Laws, and my one method of attack is virtually useless. In short, I don't know that I can help you, Stephen.'

The Co-ordinator laughed shortly, 'Nevertheless, let me tell you the rest. Let me give you *my* theories, and perhaps you will then be able to tell me whether they are possible in the light of roboticspsychology.'

'By all means. Go ahead.'

'Well, since the Machines are giving the wrong answers, then, assuming that they cannot be in error, there is only one possibility. *They are being given the wrong data!* In other words, the trouble is human, and not robotic. So I took my recent planetary inspection tour—'

'From which you have just returned to New York.'

'Yes. It was necessary, you see, since there are four

Machines, one handling each of the Planetary Regions. And *all four are yielding imperfect results.*'

'Oh, but that follows, Stephen. If any one of the Machines is imperfect, that will automatically reflect in the result of the other three, since each of the others will assume as part of the data on which they base their own decisions, the perfection of the imperfect fourth. With a false assumption, they will yield false answers.'

'Uh-huh. So it seemed to me. Now, I have here the records of my interviews with each of the Regional Vice-Co-ordinators. Would you look through them with me? —Oh, and first, have you heard of the "Society for Humanity"?''

'Umm, yes. They are an outgrowth of the Fundamentalists who have kept U.S. Robots from ever employing positronic robots on the grounds of unfair labor competition and so on. The "Society for Humanity" itself is anti-Machine, is it not?'

'Yes, yes, but— Well, you will see. Shall we begin? We'll start with the Eastern Region.'

'As you say—'

The Eastern Region

a—Area: 7,500,000 square miles

b—Population: 1,700,000,000

c—Capital: Shanghai

Ching Hso-lin's great-grandfather had been killed in the Japanese invasion of the old Chinese Republic, and there had been no one beside his dutiful children to mourn his loss or even to know he was lost. Ching Hso-lin's grandfather had survived the civil war of the late forties, but there had been no one beside *his* dutiful children to know or care of that.

And yet Ching Hso-lin was a Regional Vice-Co-ordinator, with the economic welfare of half the people of Earth in his care.

Perhaps it was with the thought of all that in mind, that Ching had two maps as the only ornaments on the wall of his office. One was an old hand-drawn affair tracing out an acre or two of land, and marked with the now outmoded pictographs of old China: A little creek trickled aslant the faded markings and there were the delicate pictorial indications of lowly huts, in one of which Ching's grandfather had been born.

The other map was a huge one, sharply delineated, with all

markings in neat Cyrillic characters. The red boundary that marked the Eastern Region swept within its grand confines all that had once been China, India, Burma, Indo-China, and Indonesia. On it, within the old province of Szechuan, so light and gentle that none could see it, was the little mark placed there by Ching which indicated the location of his ancestral farm.

Ching stood before these maps as he spoke to Stephen Byerley in precise English, 'No one knows better than you, Mr. Co-ordinator, that my job, to a large extent, is a sinecure. It carries with it a certain social standing, and I represent a convenient focal point for administration, but otherwise it is the Machine! —The Machine does all the work. What did you think, for instance, of the Tientsin Hydroponics works?'

'Tremendous!' said Byerley.

'It is but one of dozens, and not the largest. Shanghai, Calcutta, Batavia, Bangkok— They are widely spread and they are the answer to feeding the billion and three quarters of the East.'

'And yet,' said Byerley, 'you have an unemployment problem there at Tientsin. Can you be over-producing? It is incongruous to think of Asia as suffering from too much food.'

Ching's dark eyes crinkled at the edges. 'No. It has not come to that yet. It is true that over the last few months, several vats at Tientsin have been shut down, but it is nothing serious. The men have been released only temporarily and those who do not care to work in other fields have been shipped to Colombo in Ceylon, where a new plant is being put into operation.'

'But why should the vats be closed down?'

Ching smiled gently, 'You do not know much of hydroponics, I see. Well, that is not surprising. You are a Northerner, and there soil farming is still profitable. It is fashionable in the North to think of hydroponics, when it is thought of at all, as a device for growing turnips in a chemical solution, and so it is — in an infinitely complicated way.'

'In the first place, by far the largest crop we deal with (and the percentage is growing) is yeast. We have upward of two thousand strains of yeast in production and new strains are added monthly. The basic food-chemicals of the various yeasts are nitrates and phosphates among the inorganics together with proper amounts of the trace metals needed, down

to the fractional parts per million of boron and molybdenum which are required. The organic matter is mostly sugar mixtures derived from the hydrolysis of cellulose, but, in addition, there are various food factors which must be added.

'For a successful hydroponics industry — one which can feed seventeen hundred million people — we must engage in an immense reforestation program throughout the East; we must have huge wood-conversion plants to deal with our southern jungles; we must have power, and steel, and chemical synthetics above all.'

'Why the last, sir?'

'Because, Mr. Byerley, these strains of yeast have each their peculiar properties. We have developed, as I said, two thousand strains. The beef steak you thought you ate today was yeast. The frozen fruit confection you had for dessert was iced yeast. We have filtered yeast juice with the taste, appearance, and all the food value of milk.'

'It is flavor, more than anything else, you see, that makes yeast feeding popular and for the sake of flavor we have developed artificial, domesticated strains that can no longer support themselves on a basic diet of salts and sugar. One needs biotin; another needs pteroylglutamic acid; still others need seventeen different amino acids supplied them as well as all the Vitamins B, but one (and yet it is popular and we cannot, with economic sense, abandon it)—'

Byerley stirred in his seat, 'To what purpose do you tell me all this?'

'You asked me, sir, why men are out of work in Tientsin. I have a little more to explain. It is not only that we must have these various and varying foods for our yeast; but there remains the complicating factor of popular fads with passing time; and of the possibility of the development of new strains with the new requirements and new popularity. All this must be foreseen, and the Machine does the job—'

'But not perfectly.'

'Not very *imperfectly*, in view of the complications I have mentioned. Well, then, a few thousand workers in Tientsin are temporarily out of a job. But, consider this, the amount of waste in this past year (waste that is, in terms of either defective supply or defective demand) amounts to not one-tenth of one percent of our total productive turnover. I consider that—'

'Yet in the first years of the Machine, the figure was nearer one-thousandth of one percent.'

'Ah, but in the decade since the Machine began its operations in real earnest, we have made use of it to increase our old pre-Machine yeast industry twenty-fold. You expect imperfections to increase with complications, though—'

'Though?'

'There *was* the curious instance of Rama Vrasayana.'

'What happened to him?'

'Vrasayana was in charge of a brine-evaporation plant for the production of iodine, with which yeast can do without, but human beings not. His plant was forced into receiver-ship.'

'Really? And through what agency?'

'Competition, believe it or not. In general, one of the chiefest functions of the Machine's analyses is to indicate the most efficient distribution of our producing units. It is obviously faulty to have areas insufficiently serviced, so that the transportation costs account for too great a percentage of the overhead. Similarly, it is faulty to have an area too well serviced, so that factories must be run at lowered capacities, or else compete harmfully with one another. In the case of Vrasayana, another plant was established in the same city, and with a more efficient extracting system.'

'The Machine permitted it?'

'Oh, certainly. That is not surprising. The new system is becoming widespread. The surprise is that the Machine failed to warn Vrasayana to renovate or combine. —Still, no matter. Vrasayana accepted a job as engineer in the new plant, and if his responsibility and pay are now less, he is not actually suffering. The workers found employment easily; the old plant has been converted to — something or other. Something useful. We left it all to the Machine.'

'And otherwise you have no complaints.'

'None!'

The Tropic Region:

a—Area: 22,000,000 square miles

b—Population: 500,000,000

c—Capital: Capital City

The map in Lincoln Ngoma's office was far from the model of neat precision of the one in Ching's Shanghai dominion.

The boundaries of Ngoma's Tropic Region were stencilled in dark, wide brown and swept about a gorgeous interior labelled 'jungle' and 'desert' and 'here be Elephants and all Manner of Strange Beasts.'

It had much to sweep, for in land area the Tropic Region enclosed most of two continents: all of South America north of Argentina and all of Africa south of the Atlas. It included North America south of the Rio Grande as well, and even Arabia and Iran in Asia. It was the reverse of the Eastern Region. Where the ant hives of the Orient crowded half of humanity into 15 per cent of the land mass, the Tropics stretched its 15 per cent of Humanity over nearly half of all the land in the world.

But it was growing. It was the one Region whose population increase through immigration exceeded that through births. —And for all who came it had use.

To Ngoma, Stephen Byerley seemed like one of these immigrants, a pale searcher for the creative work of carving a harsh environment into the softness necessary for man, and he felt some of that automatic contempt of the strong man born to the strong Tropics for the unfortunate pallards of the colder suns.

The Tropics had the newest capital city on Earth, and it was called simply that: 'Capital City', in the sublime confidence of youth. It spread brightly over the fertile uplands of Nigeria and outside Ngoma's windows, far below, was life and color; the bright, bright sun and the quick, drenching showers. Even the squawking of the rainbowed birds was brisk and the stars were hard pinpoints in the sharp night.

Ngoma laughed. He was a big, dark man, strong faced and handsome.

'Sure,' he said, and his English was colloquial and mouth-filling, 'the Mexican Canal is overdue. What the hell? It will get finished just the same, old boy.'

'It was doing well up to the last half year.'

Ngoma looked at Byerley and slowly crunched his teeth over the end of a big cigar, spitting out one end and lighting the other, 'Is this an official investigation, Byerley? What's going on?'

'Nothing. Nothing at all. It's just my function as Co-ordinator to be curious.'

'Well, if it's just that you are filling in a dull moment, the

truth is that we're always short on labor. There's lots going on in the Tropics. The Canal is only one of them—'

'But doesn't your Machine predict the amount of labor available for the Canal, - allowing for all the competing projects?'

Ngoma placed one hand behind his neck and blew smoke rings at the ceiling, 'It was a little off.'

'Is it often a little off?'

'Not oftener than you would expect. —We don't expect too much of it, Byerley. We feed it data. We take its results. We do what it says. —But it's just a convenience; just a labor-saving device. We could do without it, if we had to. Maybe not as well. Maybe not as quickly. But we'd get there.'

'We've got confidence out here, Byerley, and that's the secret. Confidence! We've got new land that's been waiting for us for thousands of years, while the rest of the world was being ripped apart in the lousy fumbblings of pre-atomic time. We don't have to eat yeast like the Eastern boys, and we don't have to worry about the stale dregs of the last century like you Northerners.'

'We've wiped out the tsetse fly and the Anopheles mosquito, and people find they can live in the sun and like it, now. We've thinned down the jungles and found soil; we've watered the deserts and found gardens. We've got coal and oil in untouched fields, and minerals out of count.'

'Just step back. That's all we ask the rest of the world to do. —Step back, and let us work.'

Byerley said, prosaically, 'But the Canal, - it was on schedule six months ago. What happened?'

Ngoma spread his hands, 'Labor troubles.' He felt through a pile of papers skeltered about his desk and gave it up.

'Had something on the matter here,' he muttered, 'but never mind. There was a work shortage somewhere in Mexico once on the question of women. There weren't enough women in the neighborhood. It seemed no one had thought of feeding sexual data to the Machine.'

He stopped to laugh, delightedly, then sobered, 'Wait a while. I think I've got it. —Villafranca?'

'Villafranca?'

'Francisco Villafranca. —He was the engineer in charge. Now let me straighten it out. Something happened and there was a cave-in. Right. Right. That was it. Nobody died, as I

remember, but it made a hell of a mess. —Quite a scandal.'

'Oh?'

'There was some mistake in his calculations. —Or at least, the Machine said so. They fed through Villafranca's data, assumptions, and so on. The stuff he had started with. The answers came out differently. It seems the answers Villafranca had used didn't take account of the effect of a heavy rainfall on the contours of the cut. —Or something like that. I'm not an engineer, you understand.'

'Anyway, Villafranca put up a devil of a squawk. He claimed the Machine's answer had been different the first time. That he had followed the Machine faithfully. Then he quit! We offered to hold him on - reasonable doubt, previous work satisfactory, and all that - in a subordinate position, of course - had to do that much - mistakes can't go unnoticed - bad for discipline— Where was I?'

'You offered to hold him.'

'Oh yes. He refused. —Well, take all in all, we're two months behind. Hell, that's nothing.'

Byerley stretched out his hand and let the fingers tap lightly on the desk, 'Villafranca blamed the Machine, did he?'

'Well, he wasn't going to blame himself, was he? Let's face it; human nature is an old friend of ours. Besides, I remember something else now— Why the hell can't I find documents when I want them? My filing system isn't worth a damn— This Villafranca was a member of one of your Northern organizations. Mexico is too close to the North, that's part of the trouble.'

'Which organization are you speaking of?'

'The Society for Humanity, they call it. He used to attend the annual conferences in New York, Villafranca did. Bunch of crackpots, but harmless. —They don't like the Machines; claim they're destroying human initiative. So naturally Villafranca would blame the Machine. —Don't understand that group myself. Does Capital City look as if the human race were running out of initiative?'

And Capital City stretched out in golden glory under a golden sun, - the newest and youngest creation of *Homo metropolis*.

The European Region

a—Area: 4,000,000 square miles

b—Population: 300,000,000

c—Capital: Geneva

The European Region was an anomaly in several ways. In area, it was far the smallest; not one fifth the size of the Tropic Region in area, and not one fifth the size of the Eastern Region in population. Geographically, it was only somewhat similar to pre-Atomic Europe, since it excluded what had once been European Russia and what had once been the British Isles, while it included the Mediterranean coasts of Africa and Asia, and, in a queer jump across the Atlantic, Argentina, Chile, and Uruguay as well.

Nor was it likely to improve its relative status *vis-à-vis* the other regions of Earth, except for what vigor the South American provinces lent it. Of all the Regions, it alone showed a positive population decline over the past half century. It alone had not seriously expanded its productive facilities, or offered anything radically new to human culture.

'Europe,' said Madame Szegeczowska, in her soft French, 'is essentially an economic appendage of the Northern Region. We know it, and it doesn't matter.'

And as though in resigned acceptance of a lack of individuality, there was no map of Europe on the wall of the Madame Co-ordinator's office.

'And yet,' pointed out Byerley, 'you have a Machine of your own, and you are certainly under no economic pressure from across the ocean.'

'A Machine! Bah!' She shrugged her delicate shoulders, and allowed a thin smile to cross her little face as she tamped out a cigarette with long fingers. 'Europe is a sleepy place. And such of our men as do not manage to emigrate to the Tropics are tired and sleepy along with it. You see for yourself that it is myself, a poor woman, to whom falls the task of being Vice-Co-ordinator. Well, fortunately, it is not a difficult job, and not much is expected of me.'

'As for the Machine— What can it say but "Do this and it will be best for you." But what is best for us? Why, to be an economic appendage of the Northern Region.'

'And is it so terrible? No wars! We live in peace — and it is pleasant after seven thousand years of war. We are old, monsieur. In our borders, we have the regions where Occidental civilization was cradled. We have Egypt and Mesopotamia;

Crete and Syria; Asia Minor and Greece. —But old age is not necessarily an unhappy time. It can be a fruition—'

'Perhaps you are right,' said Byerley, affably. 'At least the tempo of life is not as intense as in the other Regions. It is a pleasant atmosphere.'

'Is it not? —Tea is being brought, monsieur. If you will indicate your cream and sugar preferences, please. —Thank you.'

She sipped gently, then continued, 'It is pleasant. The rest of Earth is welcome to the continuing struggle. I find a parallel here; a very interesting one. There was a time when Rome was master of the world. It had adopted the culture and civilization of Greece; a Greece which had never been united, which had ruined itself with war, and which was ending in a state of decadent squalor. Rome united it, brought it peace and let it live a life of secure non-glory. It occupied itself with its philosophies and its art, far from the clash of growth and war. It was a sort of death, but it was restful, and it lasted with minor breaks for some four hundred years.'

'And yet,' said Byerley, 'Rome fell eventually, and the optimum dream was over.'

'There are no longer barbarians to overthrow civilization.' 'We can be our own barbarians, Madame Szegeczowska. —Oh, I meant to ask you. The Almaden mercury mines have fallen off quite badly in production. Surely the ores are not declining more rapidly than anticipated?'

The little woman's gray eyes fastened shrewdly on Byerley, 'Barbarians — the fall of civilization — possible failure of the Machine. Your thought processes are very transparent, monsieur.'

'Are they?' Byerley smiled. 'I see that I should have had men to deal with as hitherto. —You consider the Almaden affair to be the fault of the Machine?'

'Not at all, but I think you do. You, yourself, are a native of the Northern Region. The Central Co-ordination Office is at New York. —And I have noticed for quite a while that you Northerners lack somewhat of faith in the Machine.'

'We do?'

'There is your "Society for Humanity" which is strong in the North, but naturally fails to find many recruits in tired, old Europe, which is quite willing to let feeble Humanity alone

for a while. Surely, you are one of the confident North and not one of the cynical old continent.'

'This has a connection with Almaden?'

'Oh, yes, I think so. The mines are in the control of Consolidated Cinnabar, which is certainly a Northern company, with headquarters at Nikolaev. Personally, I wonder if the Board of Directors have been consulting the Machine at all. They said they had in our conference last month, and, of course, we have no evidence that they did not, but I wouldn't take the word of a Northerner in this matter - no offense intended - under any circumstances. —Nevertheless, I think it will have a fortunate ending.'

'In what way, my dear madame?'

'You must understand that the economic irregularities of the last few months, which, although small as compared with the great storms of the past, are quite disturbing to our peace-drenched spirits, have caused considerable restiveness in the Spanish province. I understand that Consolidated Cinnabar is selling out to a group of native Spaniards. It is consoling. If we are economic vassals of the North, it is humiliating to have the fact advertised too blatantly. —And our people can be better trusted to follow the Machine.'

'Then you think there will be no more trouble?'

'I am sure there will not be— In Almaden, at least.'

The Northern Region

a—Area: 18,000,000 square miles

b—Population: 800,000,000

c—Capital: Ottawa

The Northern Region, in more ways than one, was at the top. This was exemplified quite well by the map in the Ottawa office of Vice-Co-ordinator Hiram Mackenzie, in which the North Pole was centered. Except for the enclave of Europe with its Scandinavian and Icelandic regions, all the Arctic area was within the Northern Region.

Roughly, it could be divided into two major areas. To the left on the map was all of North America above the Rio Grande. To the right was included all of what had once been the Soviet Union. Together these areas represented the centered power of the planet in the first years of the Atomic Age. Between the two was Great Britain, a tongue of the Region licking at Europe. Up at the top of the map, distorted into

odd, huge shapes, were Australia and New Zealand, also member provinces of the Region.

Not all the changes of the past decades had yet altered the fact that the North was the economic ruler of the planet.

There was almost as ostentatious symbolism thereof in the fact that of the official Regional maps Byerley had seen, Mackenzie's alone showed all the Earth, as though the North feared no competition and needed no favoritism to point up its pre-eminence.

'Impossible,' said Mackenzie, dourly, over the whiskey. 'Mr. Byerley, you have had no training as a robot technician, I believe.'

'No, I have not.'

'Hmp. Well, it is, in my opinion, a sad thing that Ching, Ngoma and Szegeczowska haven't either. There is too prevalent an opinion among the peoples of Earth that a Co-ordinator need only be a capable organizer, a broad generalizer, and an amiable person. These days he should know his robotics as well, - no offense intended.'

'None taken. I agree with you.'

'I take it, for instance, from what you have said already, that you worry about the recent trifling dislocations in world economy. I don't know what you suspect, but it has happened in the past that people - who should have known better - wondered what would happen if false data were fed into the Machine.'

'And what would happen, Mr. Mackenzie?'

'Well,' the Scotsman shifted his weight and sighed, 'all collected data goes through a complicated screening system which involves both human and mechanical checking, so that the problem is not likely to arise. —But let us ignore that. Humans are fallible, also corruptible, and ordinary mechanical devices are liable to mechanical failure.'

'The real point of the matter is that what we call a "wrong datum" is one which is inconsistent with all other known data. It is our only criterion of right and wrong. It is the Machine's as well. Order it, for instance, to direct agricultural activity on the basis of an average July temperature in Iowa of 57 degrees Fahrenheit. It won't accept that. It will not give an answer. —Not that it has any prejudice against that particular temperature, or that an answer is impossible; but because, in the light of all the other data fed it over a

period of years, it knows that the probability of an average July temperature of 57 is virtually nil. It rejects that datum.

'The only way a "wrong datum" can be forced on the Machine is to include it as part of a self-consistent whole, all of which is subtly wrong in a manner either too delicate for the Machine to detect or outside the Machine's experience. The former is beyond human capacity, and the latter is almost so, and is becoming more nearly so as the Machine's experience increases by the second.'

Stephen Byerley placed two fingers to the bridge of his nose, 'Then the Machine cannot be tampered with— And how do you account for recent errors, then?'

'My dear Byerley, I see that you instinctively follow that great error — that the Machine knows all. Let me cite you a case from my personal experience. The cotton industry engages experienced buyers who purchase cotton. Their procedure is to pull a tuft of cotton out of a random bale of a lot. They will look at that tuft and feel it, tease it out, listen to the crackling perhaps as they do so, touch it with their tongue, — and through this procedure they will determine the class of cotton the bales represent. There are about a dozen such classes. As a result of their decisions, purchases are made at certain prices, blends are made in certain proportions. — Now these buyers cannot yet be replaced by the Machine.'

'Why not? Surely the data involved is not too complicated for it?'

'Probably not. But what data is this you refer to? No textile chemist knows exactly what it is that the buyer tests when he feels a tuft of cotton. Presumably there's the average length of the threads, their feel, the extent and nature of their slickness, the way they hang together and so on. — Several dozen items, subconsciously weighed, out of years of experience. But the *quantitative* nature of these tests is not known; maybe even the very nature of some of them is not known. So we have nothing to feed the Machine. Nor can the buyers explain their own judgment. They can only say, 'Well, look at it. Can't you *tell* it's class-such-and-such?''

'I see.'

'There are innumerable cases like that. The Machine is only a tool after all, which can help humanity progress faster by taking some of the burdens of calculations and interpretations off his back. The task of the human brain remains what it has

always been; that of discovering new data to be analyzed, and of devising new concepts to be tested. A pity the Society for Humanity won't understand that.'

'They are against the Machine?'

'They would be against mathematics or against the art of writing if they had lived at the appropriate time. These reactionaries of the Society claim the Machine robs man of his soul. I notice that capable men are still at a premium in our society; we still need the man who is intelligent enough to think of the proper questions to ask. Perhaps if we could find enough of such, these dislocations you worry about, Co-ordinator, wouldn't occur.'

Earth (Including the uninhabited continent, Antarctica)

a—Area: 54,000,000 square miles (land surface)

b—Population: 3,300,000,000

c—Capital: New York

The fire behind the quartz was weary now, and sputtered its reluctant way to death.

The Co-ordinator was somber, his mood matching the sinking flame.

'They all minimize the state of affairs.' His voice was low. 'Is it not easy to imagine that they all laugh at me? And yet — Vincent Silver said the Machines cannot be out of order, and I must believe him. Hiram Mackenzie says they cannot be fed false data, and I must believe him. But the Machines are going wrong, somehow, and I must believe that, too, — and so there is *still* an alternative left.'

He glanced sidewise at Susan Calvin, who, with closed eyes, for a moment seemed asleep.

'What is that?' she asked, prompt to her cue, nevertheless.

'Why, that correct data is indeed given, and correct answers are indeed received, but that they are then ignored. There is no way the Machine can enforce obedience to its dictates.'

'Madame Szegeczowska hinted as much, with reference to Northerners in general, it seems to me.'

'So she did.'

'And what purpose is served by disobeying the Machine? Let's consider motivations.'

'It's obvious to me, and should be to you. It is a matter of rocking the boat, deliberately. There can be no serious conflicts on Earth, in which one group or another can seize more

power than it has for what it thinks is its own good despite the harm to Mankind as a whole, while the Machines rule. If popular faith in the Machines can be destroyed to the point where they are abandoned, it will be the law of the jungle again. —And not one of the four Regions can be freed of the suspicion of wanting just that.

'The East has half of humanity within its borders, and the Tropics more than half of Earth's resources. Each can feel itself the natural rulers of all Earth, and each has a history of humiliation by the North, for which it can be human enough to wish a senseless revenge. Europe has a tradition of greatness, on the other hand. It once *did* rule the Earth, and there is nothing so eternally adhesive as the memory of power.

'Yet, in another way, it's hard to believe. Both the East and the Tropics are in a state of enormous expansion within their own borders. Both are climbing incredibly. They cannot have the spare energy for military adventures. And Europe can have nothing but its dreams. It is a cipher, militarily.'

'So, Stephen,' said Susan, 'you leave the North.'

'Yes,' said Byerley, energetically, 'I do. The North is now the strongest, and has been for nearly a century, or its component parts have been. But it is losing relatively, now. The Tropic Regions may take their place in the forefront of civilization for the first time since the Pharaohs, and there are Northerners who fear that.

'The "Society for Humanity" is a Northern organization, primarily, you know, and they make no secret of not wanting the Machines. —Susan, they are few in numbers, but it is an association of powerful men. Heads of factories; directors of industries and agricultural combines who hate to be what they call "the Machine's office-boy" belong to it. Men with ambition belong to it. Men who feel themselves strong enough to decide for themselves what is best for themselves, and not just to be told what is best for others.

'In short, just those men who, by together refusing to accept the decisions of the Machine, can, in a short time, turn the world topsy-turvy; — just those belong to the Society.

'Susan, it hangs together. Five of the Directors of World Steel are members, and World Steel suffers from overproduction. Consolidated Cinnabar, which mined mercury at Almaden, was a Northern concern. Its books are still being investigated, but one, at least, of the men concerned was a

member. Francisco Villafranca, who, singlehanded, delayed the Mexican Canal for two months, was a member, we know already — and so was Rama Vrasayana, I was not at all surprised to find out.'

Susan said, quietly, 'These men, I might point out, have all done badly—'

'But naturally,' interjected Byerley. 'To disobey the Machine's analyses is to follow a non-optimal path. Results are poorer than they might be. It's the price they pay. They will have it rough now but in the confusion that will eventually follow—'

'Just what do you plan doing, Stephen?'

'There is obviously no time to lose. I am going to have the Society outlawed, every member removed from any responsible post. And all executive and technical positions, henceforward, can be filled only by applicants signing a non-Society oath. It will mean a certain surrender of basic civil liberties, but I am sure the Congress—'

'It won't work!'

'What!— Why not?'

'I will make a prediction. If you try any such thing, you will find yourself hampered at every turn. You will find it impossible to carry out. You will find your every move in that direction will result in trouble.'

Byerley was taken aback, 'Why do you say that? —I was rather hoping for your approval in this matter.'

'You can't have it as long as your actions are based on a false premise. You admit the Machine can't be wrong, and can't be fed wrong data. I will now show you that it cannot be disobeyed, either, as you think is being done by the Society.'

'That I don't see at all.'

'Then listen. Every action by any executive which does not follow the exact directions of the Machine he is working with becomes part of the data for the next problem. The Machine, therefore, knows that the executive has a certain tendency to disobey. He can incorporate that tendency into that data, — even quantitatively, that is, judging exactly how much and in what direction disobedience would occur. Its next answers would be just sufficiently biased so that after the executive concerned disobeyed, he would have automatically corrected those answers to optimal directions. The Machine *knows*, Stephen!'

'You can't be sure of all this. You are guessing.'

'It is a guess based on a lifetime's experience with robots. You had better rely on such a guess, Stephen.'

'But then what is left? The Machines themselves are correct and the premises they work on are correct. That we have agreed upon. Now you say that it cannot be disobeyed. Then what is wrong?'

'You have answered yourself. *Nothing is wrong!* Think about the Machines for a while, Stephen. They are robots, and they follow the First Law. But the Machines work not for any single human being, but for all humanity, so that the First Law becomes: "No Machine may harm humanity; or, through inaction, allow humanity to come to harm."

'Very well, then, Stephen, what harms humanity? Economic dislocations most of all, from whatever cause. Wouldn't you say so?'

'I would.'

'And what is most likely in the future to cause economic dislocations? Answer that, Stephen.'

'I should say,' replied Byerley, unwillingly, 'the destruction of the Machines.'

'And so should I say, and so should the Machines say. Their first care, therefore, is to preserve themselves, for us. And so they are quietly taking care of the only elements left that threaten them. It is not the "Society for Humanity" which is shaking the boat so that the Machines may be destroyed. You have been looking at the reverse of the picture. Say rather that the Machine is shaking the boat - *very* slightly - just enough to shake loose those few which cling to the side for purposes the Machines consider harmful to Humanity.'

'So Vrasayana loses his factory and gets another job where he can do no harm - he is not badly hurt, he is not rendered incapable of earning a living, for the Machine cannot harm a human being more than minimally, and that only to save a greater number. Consolidated Cinnabar loses control at Almaden. Villafranca is no longer a civil engineer in charge of an important project. And the directors of World Steel are losing their grip on the industry - or will.'

'But you don't really know all this,' insisted Byerley, distractedly. 'How can we possibly take a chance on your being right?'

'You must. Do you remember the Machine's own statement when you presented the problem to him? It was: "The matter admits of no explanation". The Machine did not say there was no explanation, or that it could determine no explanation. It simply was not going to *admit* any explanation. In other words, it would be harmful to humanity to have the explanation known, and that's why we can only guess - and keep on guessing.'

'But how can the explanation do us harm? Assume that you are right, Susan.'

'Why, Stephen, if I am right, it means that the Machine is conducting our future for us not only simply in direct answer to our direct questions, but in general answer to the world situation and to human psychology as a whole. And to know that may make us unhappy and may hurt our pride. The Machine cannot, *must* not, make us unhappy.'

'Stephen, how do we know what the ultimate good of Humanity will entail? We haven't at *our* disposal the infinite factors that the Machine has at *its!* Perhaps, to give you a not unfamiliar example, our entire technical civilization has created more unhappiness and misery than it has removed. Perhaps an agrarian or pastoral civilization, with less culture and less people would be better. If so, the Machines must move in that direction, preferably without telling us, since in our ignorant prejudices we only know that what we are used to is good - and we would then fight change. Or perhaps a complete urbanization, or a completely caste-ridden society, or complete anarchy, is the answer. We don't know. Only the Machines know, and they are going there and taking us with them.'

'But you are telling me, Susan, that the "Society for Humanity" is right; and that Mankind *has* lost its own say in its future.'

'It never had any, really. It was always at the mercy of economic and sociological forces it did not understand - at the whims of climate, and the fortunes of war. Now the Machines understand them; and no one can stop them, since the Machines will deal with them as they are dealing with the Society, - having, as they do, the greatest of weapons at their disposal, the absolute control of our economy.'

'How horrible!'

'Perhaps how wonderful! Think, that for all time, all con-

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flicts are finally evitable. Only the Machines, from now on, are inevitable!

And the fire behind the quartz went out and only a curl of smoke was left to indicate its place.

'And that is all,' said Dr. Calvin, rising. 'I saw it from the beginning, when the poor robots couldn't speak, to the end, when they stand between mankind and destruction. I will see no more. My life is over. You will see what comes next.'

I never saw Susan Calvin again. She died last month at the age of eighty-two.