

**Part 1**

**Scientific Communities in Africa**

## Sisyphus or the Scientific Communities of Algeria

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### Epigraph

We finished writing this text in February 1993. At that time, we were both struck very much by the intensive hive of ideas fuelling Algerian researchers. The final note of our historical retrospective was an optimistic one. It reflected the hopes of the engineers, doctors and academicians we had interviewed. Not long afterwards—in March 1993 to be exact—a number of them began getting murdered; many would flee the country fearing for their lives. The Algerian scientific community—along with women—became the victims of the cultural mayhem tearing through the country. An easy target for hired killers, it crumbled before our very eyes within a matter of months. This tragic fate shows the extent to which it had become a rallying light in the darkness of the antagonism gnawing deep into the guts of society. It serves to indicate how fragile the structure of a national scientific community can be in the countries of the South. And yet, we can also see how, by fleeing lands of persecution, it can bounce back and enrich more welcoming regions abroad; regions that are ready to bring such members into the fold of the world scientific community.

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The story of Algeria's scientific communities is doubly paradoxical. On the one hand, their rapid development came late, without links to any local tradition whatsoever. Also, having emerged on a wave of nationalistic voluntarism, they were first sustained by the state, only to see it shed its support at a delicate point just as a new generation was about to take the helm. They then found themselves stripped of their legitimacy and burdened with the need to re-establish a place in society.

We begin by looking at these developments as a three-stage life cycle: indifference, development, and then, disintegration and possible restructuring. After that, we shall go on to discuss the present-day situation with its fundamental key points: the withdrawal of the state and the ensuing necessary measures to regain recognition, the language conflict, scientist migration and community reproduction problems, opportune niches and

accommodating professions, and styles of science and conflicting schools of thought.

### **Colonial Legacy**

When French colonization swept into Algeria in 1830, the country had its literates, popular knowledge and organized intelligentsia. Yet, it lacked an uninterrupted line linking it back to the tradition of classical Arabic science of the eighth to thirteenth centuries. Algeria had not been an epicentre of it and its methodical practice had long since died out. There followed the building of a colonial science, which could well have been handed on as a legacy to independent Algeria. It too constituted a mishit. Right from the very beginning, the powers of Western science (medicine in particular) set themselves up throughout the country to rally people and modify their view of the world. A deep ideological struggle ensued which, in less than a century, crippled the body of popular knowledge. Science, it must be said, was not just a colonizing tool; it was also fuelled by real curiosity. From 1837 onwards, an official scientific mission spent ten years travelling the length and breadth of the country. It was to lastingly introduce geodesy and geography, 'natural history' and anthropology. It trained and encouraged many local enthusiasts—military men, doctors, settlers and civil servants—who swiftly organized themselves into scientific associations. All of them originally came from the metropolis. A genuine scientific lobby then secured the (contested) creation of a fully working university at Algiers in 1909. It was to remain the only one of its kind in the French Empire. From that point on, scientific activity began to take roots in Algeria: laboratories were set up at the faculty (notably in the natural sciences), specialist reviews burgeoned and the scientist associations came under academic rule.

Meanwhile, Paris based large metropolitan institutions such as le Muséum d'Histoire Naturelle (MHN), les Instituts Pasteur and l'Académie des Sciences started taking a strategic interest in establishing networking ties and observatories. MHN was given a new lease of life when it persuaded the ministries to try out its new 'acclimatization' theories in colonial 'botanical gardens'—the best and most illustrious of them was that of Algiers established in 1832. In 1880, in the name of the 'universal science watch', the prestigious Académie des Sciences established an astronomical and geophysical observatory in Algeria under its own seal and control. The followers of Pasteur, who were promoting a new school of thought, needed to prove their worth and build up prestige in peripheral branches. In 1894, an overseas branch of the Institut Pasteur was established in Algiers to join the list of those set up at the same period in other colonies. These newly installed establishments provided a number of great scientists with theatres

of operations from which many important discoveries were to emerge. Some would be awarded the Nobel Prize, e.g., the first parasitology work on malaria.<sup>2</sup>

In the aftermath of the First World War, a change in the colonial doctrines produced 'agricultural experimentation stations'.<sup>3</sup> Into these forerunners of the agricultural research centres, agricultural engineers introduced both genetics (a fringe discipline in metropolitan universities and better known to them) and 'development' concerns. Botany and zoology, for groundwork rather than utilitarian purposes, were either taken under the wing of enthusiasts or went into decline, and with them went the botanical gardens. Following the Second World War, a further change in the hierarchy of politico-economic concerns and scientific doctrines led to a final wave of institution-building. There were three sides to this: respect for the techno-sciences prevailed, the foundations of 'autonomy' were laid in the colonies and interest grew in the Sahara (French atomic test site). A Centre de Recherches Nucléaires and Centre Pierre et Marie Curie (involved in radiology, haematology and nuclear medicine) were set up; and the Centre de Géophysique was consolidated as was, among others, the Centre de Recherches Sahariennes.

However, towards the late 1950s the Algerian War of Liberation was brewing. Looking back at the earlier episodes gives us a list of the institutions the independent government would inherit. Yet, many of the scientific institutions established had not been fully institutionalized, in the sense that they would not be able to sustain themselves with local resources, both human and material, in the event of a political upheaval. They had been operating neither as educational incubators nor as anchorage points for new schools of thought, working to carve out a forthcoming, local style of science. In the event of independence, their premises and equipment would be handed down only as empty shells since most of the researchers who had been running them were French and would leave the country with no intention of ever returning. The institutions had not prepared a relief team. The few 'Muslim' students educated at the university were mainly engaged in professions rather than research, e.g., chemists, doctors and lawyers. It was in the high schools and teacher training colleges that an active exchange of ideas and a taste for science had only recently begun. Another problem was that many Algerian graduates were abroad in the diaspora and being trained in very different surroundings. As for the independent government, being absorbed in emergency measures, it would consistently leave the scientific institutions it inherited aside for some time to come.

## Science and Independence

### The First Period—1962-1974: Indifference

The independence of Algeria in July 1962 was to release the country from a colonial rule that had become intolerable for both the working classes, subjected to survival under the settler's yoke, and the delicately poised elites—Arabic speaking or 'Frenchified'—who had successfully avoided being bulldozed into impoverishment. Colonization here had, unlike in Tunisia or Morocco, been total, profound and radical. This left the Algerian people no alternative other than to achieve independence through a corresponding reaction of the same order—total, profound and radical. Independence came in a violent clash between the two communities. Beyond this, it was a rupture in the fullest sense of the term: the French beat a mass and disorderly retreat, leaving the Algerians to manage the economic and administrative machinery and technological infrastructure—a mammoth task for which they had neither the necessary experience nor ability. All analyses show that in Algeria, the colonial political system had doggedly pursued a tough line in containment strategy. Very few Algerians were able to reach even middle management levels in the administration, economy or education and, moreover, very few were qualified to acquire the skills such functions demanded.<sup>4</sup>

The nationalist leaders had clearly been conscious of this dimension for some time. During the early 1950s, up until the armed conflict broke out in 1954; they urged students to push their studies further into subjects that would be 'useful' later on. The amount of special attention granted to S&T is remarkable. Its measure can be gauged by the often decisive role that student associations such as AEMAN, UGEMA, and UNE A<sup>5</sup> would play in the nationalist movement: far more important, to begin with at least, than that of any trade unionist, worker or peasant organizations. The UGEMA, which had been set up in 1955 and was totally aligned with the Front de Libération Nationale (FLN)'s political agenda, thus encouraged the most politically aware students to join the resistance movements after the all-out student's strike of 1956-1957. They were to form an 'inner F

gain an education and acquire competence in S&T which they would use to take over a European techno-structure, otherwise destined to vanish after independence.<sup>8</sup>

Such a pragmatic approach was undoubtedly adopted because of the needs of the time. The fact that the colonial system had trained such few Algerian technicians and scientists meant that there was now a gap to be quickly bridged so as to minimize the hardships of managing the post-independence period. It nevertheless remains a sign of the eclecticism of Algerian nationalism in this domain, contributing as we shall see later to the founding of an essentially 'positivist' approach to S&T, and whose corrupting and destructive effects would only be felt years later.

For the time being in 1961 preparations were made with all due haste. Independence was imminent and the French were leaving en masse. The country's economic and administrative machinery needed to be kept going and this concerned, among others, the complex and now vacated scientific and technical facilities that the Algerians had previously little frequented. The first graduates began returning to the country, but there were barely enough of them to take over the major posts of responsibility, when they were not being asked to deal with immediately more pressing matters in the political administration.

Algeria was counting on the quite generous amounts of international aid it was then receiving (in the 1960s and for another few years to come). Arab countries, especially Egypt, were dispatching teachers in thousands in order to provide a schooling that would hopefully be open to one and all in a democratic way. The Accords d'Evian agreement, which outlined relations between independent Algeria and its former metropolis, made possible technical assistance in S&T for the following decade. So the essence of scientific and technological cooperation was thus provided by the French state and would, for a number of years, serve to fill the gap left by the abrupt colonial 'vacuum'.<sup>9</sup> Up until the early 1970s, the new state of Algeria however managed the inherited institutions of science just to avoid the situation of leaving them empty. On-the-ground Algerian researchers received little encouragement or support

acting as 'assistant researchers mainly working in the physics, chemistry, earth sciences and biology departments.

- The Faculty of Medicine and the Institut Pasteur with forty or so researchers, half of them foreigners.

The remainder were dispersed in a few agronomy stations, small social science units—anthropology research centres in particular—and the faculties of law and economics. There were virtually none in industry, mining, hydraulics, energy, civil engineering or architecture.<sup>10</sup>

From the discussion of the first decade of Algerian independence, it is visibly difficult to talk about a *national* scientific community with solid traditions in research and supported by a stable network of research groups, libraries, laboratories, journals, etc. Also, the plans or views for a national science policy were still very far from the mind of the new state leadership. The emergencies lay elsewhere and nobody talked about scientific research. It was nonetheless a decisive decade in more ways than one. A national research 'experiment', no matter how minimal it may have been, was launched. This would provide the first steps towards defining a totally 'original-local' profile for the formation of an Algerian community of scientists. The first original feature was its 'nationalistic' tone. As mentioned earlier, this dates back to when the nationalist movement itself was formed. Political nationalism not being enough, however, the community now had to take up concrete research activity with all the commitment of a new 'cause'. What better, therefore, than to undertake 'useful' research, which at that time meant applied research. Applied science, the future ethical and political creed of this emerging community, was to be upheld by a relatively inexperienced body of practitioners who lacked ad hoc equipped research centres: colonial science had not provided any such centres for industrial sciences. This creed met the objectives of the new state leaders who were trying to make *development* the central axis of the national policy. Both scientists and state leaders alike were aiming at almost exactly the same goals. While the state was launching into a bold programme of industrial investment and the nationalization of 'foreign' property, scientists were hard at work developing research and technology, public health and social sciences—development areas which were unanimously seen as constituting the 'natural' cultural and scientific milieu of the project for a new society.

That social project was basically the work of a state conceived as a history-making force designed to provide a general framework for the evolution of a new society. Let us not forget that at that time many countries in different parts of the Third World were adapting to the pattern of state 'socialism' in varying ways. The Algerian version was an exemplary and pioneering model. After the nationalization of the hydrocarbon industry

in 1971 and the state takeover of gas and petrol resources, state control could no longer be considered as an ideology nor as just the political spin-off of a military coup d'état (in this case, that of 19 June 1965). It became an organic, economic and financial reality that none could escape, not least the fragile, fledgling 'community of science', which, like the rest of society, would eventually come to realize that state-controlled institutions were the only ones holding the keys to the future of research.

Therefore, in this stage of formation, the Algerian scientific community came to be characterized by its nationalism, developmentalism and state dominance. Already, though a certain 'style' was emerging, it came from both the recklessness of youth and a dogged strength of convictions that could not be tempered by elders or experience, since there were none. We also notice the openness to 'world science', a by-product of its members' scientific training, paradoxically coupled with their strong 'resistance to foreigners'—the fruit of their political background. During this early stage of life, the embryonic Algerian scientific community proved it had a well and truly 'pioneering' spirit. Due to its weak anchorage in the new society and its inexperience, however, the community looked to the state to take the initiative—perhaps too exclusively so. It thus put all of its energy into supporting the state's establishing of the Office National de la Recherche Scientifique (ONRS—National Scientific Research Bureau), of which it was to wear its 'uniform' and which, as any 'uniform' can, was to eventually turn into a 'straightjacket'.

### The Second Period—1974-1983: The Nationalist Upsurge

The state only started taking an interest in S&T quite late. Power changed hands in 1965. From 1966, mining and then hydrocarbon extraction were nationalized, giving the government the means with which to finance an ambitious programme of national industrialization. Huge state factories such as iron and steel and petrochemicals among others, were built. Worker communities sprang up amidst the ruins of a rural society already uprooted by the War of Liberation. In the space of a decade, half the population was urbanized. The top priority business of the day was the forging of a strong nation state. Other initiatives fell to the wayside due to differences between two long-standing rival factions of the nationalist movement: one supporting the belief that the road to freedom lay in restoring authenticity—with hardly a thought for the future; the other holding that mastering the elements was the key—'making' should thus take precedence over tending to cultural roots. The latter, and at that time the more dominant of the two, rallied its followers under the banner of 'production'. The former stood to promote the Arabic 'language' and reserved for itself the right to control

the education system. 'Technicists' had to transgress the divide to move into the world of teaching. This they did in 1970, encroaching on the area of higher education.

The resulting powerful reforms emerged on a razor's edge and in the face of the 'culturalist' faction's hostile opposition to 'industrialism'. These reforms marked a definite turning point, both for the university and the area we are concentrating on here—the research system. It was a critical juncture, in that it swiftly brought about profound institutional change; but, more importantly, it led to the rallying of the scientific community's future helmsmen and to the making of the cognitive choices that would direct the style of Algerian research for some time to come.

First of all, major changes took place at the universities. Degree courses were released from the French teaching structures. Their content was updated with a significant part being devoted to practical training. Student places and teaching posts were increased in number. Faculties (especially those of the sciences and medicine) were enhanced, equipped and raised to a place of greater importance. New faculties appeared in the provinces and the capital (Table 2.1).

**TABLE 2.1**  
**Growth of Number of Students and Degrees in Algerian Universities, 1857-1990**

| <i>Years</i> | <i>No. of Universities</i> | <i>No. of Students</i> | <i>No. of Teachers</i> | <i>No. of Degrees**</i> |
|--------------|----------------------------|------------------------|------------------------|-------------------------|
| 1857-1905    | 1                          | 600*                   | 30*                    | 7                       |
| 1906-1955    | 1                          | 2000*                  | 300*                   | 50                      |
| 1962         | 1                          | 2700                   | 300                    | 180                     |
| 1969         | 1                          | 6000                   | 700                    | 650                     |
| 1976         | 3                          | 36000                  | 5000                   | 4700                    |
| 1980         | 6                          | 51000                  | 8000                   | 6100                    |
| 1985         | -                          | 100000                 | 10500                  | 11500                   |
| 1990         | 16                         | 170000                 | 12000                  | 16000                   |

For the periods 1857-1905 and 1906 and 1955, degrees are those delivered to Muslim students only.

The number of students, teachers and degrees are averages per year.

\* Approximate figures.

\*\* Per year.

Meanwhile, new establishments of higher education, outside the universities and under the supervision of the technical ministries were busy training engineers and advanced technicians in areas where they were most needed. In the *grandes écoles* and institutes of technology, a significant amount of time was devoted to field training and practitioners began moving into the ranks of the teaching body (Table 2.2).



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number of countries abroad following the student's strike called by the

Candidates for promotion within the university system would hence be required to satisfy conditions of scientific output.

International cooperation efforts were made in some important fields of science. As the founding members of various laboratories had been trained in such a wide variety of areas in different places, they were able to call on a diversified range of partner countries. Diversification also grew to some extent as some specialist groups in areas such as ecology, mathematics and nuclear physics gradually gained in personality and renown. Evidence can be seen in the range of different languages in which Algerian work was being published, the rate of international co-authoring and the growth of networks of collaboration. In Algeria, this was more of a fact of life in the experimental than in the social sciences (which too were concerned with trying to steer clear of a possible foreign cultural imperialism).

Although ONRS was originally instituted simply to supplement the universities, in a matter of a few years it was to successfully turn research into a sector in its own right, with its own anchorage points and relative autonomy. The first laboratories seemed to outgrow their early 'sketchiness' and settled into a routine of sound work. Sure enough, the rapid expansion had not given the younger generation time to fully assimilate norms and professional ideals. Evidence can be seen in the number of applicants who only produced just a single piece of work (thesis or paper, undertaken on trial or solely for their degree). But the overall picture appears to be on the positive side, for instance in the year 1983, as can be seen in the international bibliographical database lists relating to 'visible national science' (see Table 2.3) and in ONRS's own activity reports (see Table 2.4).

**TABLE 2.3**  
**Publication Output, 1980-90**

| <i>Year</i> | <i>Publication Output</i> |
|-------------|---------------------------|
| 1980        | 127                       |
| 1983        | 208                       |
| 1986        | 110                       |
| 1990        | 106                       |

Source: PASCAL database.

**TABLE 2.4**  
**Annual Averages of Publications Indexed by ONRS, PASCAL and ISI**

| <i>Institute</i>             | <i>Publications Indexed</i>             |
|------------------------------|---|
| ONRS (Algérie) 1975-83       | 128 + 177 communications in conferences |
| Base PASCAL (France) 1981-86 | 118                                     |
| Base ISI (USA) 1981-86       | 80                                      |

However, it was at that very moment that ONRS was to be hit by a crushing onslaught. Algerian research would consequently be at great pains to recover; the episode nevertheless gave a clearer perception of the fragility and distinctive features of the formerly built structure.

The universities' desire for research was greater than that of the production sector. Industrialists had not set their sights on such advanced sectors which, in Brazil for example, were to lead the youthful computer or aeronautics firms to signing a significant number of study contracts with colleges and faculties, then to subsequently absorb those university laboratory partners into their own research centres (Botelho, 1995). Neither had the Algerian state taken the initiative to organize scientific research pre-figuring the technologies of the future, unlike in East or South-east Asia, for example.<sup>12</sup>

The big Algerian companies were quite slow in setting up engineering units, and those with their own research centres (chiefly iron and steel, petrochemicals and mining) were rare. Innovation for them took second place and they were more satisfied with ensuring that the factories installed were working to full capacity. Their felt need was for production engineers and in some cases they were anxious to ensure that the institutes of technology did not cultivate the spread of research to the detriment of in-the-field training. The technical ministries had retained their supervision of many institutes of research. They tended to consider most of these as service laboratories mainly devoted, in agriculture for example, to natural resource surveys or quality control. The technical ministries distrusted the ONRS programmes under which coordinated work projects were carried out. They feared their staff might be deflected from the production tasks which they saw to be more important.

It may be reiterated that at the time of independence, research in Algeria had been without tradition, followers or mandate. It had to build up its own legitimacy, activity by activity. Each activity had to create its own sense of meaning, within the terms of one of the 'liberating' schools of thought leading social initiatives. Research did not exactly belong to the 'production' school and defended itself against it in its efforts to win autonomy. Nor did it feel itself to be any closer to the doctrines of the 'language' school, due to its lack of interest in the innovation and quality of the contents. The overall recognition that was granted during the lifetime of ONRS came due to state support. One of the dangers was that it might be sucked into becoming a 'state science' and become afflicted by its flaws. Another was that it could easily perish with a change of government. ONRS managed to avoid the first in spite of its code of ethics being one of a national, development-oriented science. It was saved by its promoter's strategy of subject selection, though not in every discipline (we shall come back to this later on). But the latter pitfall claimed its own victims.

During this period, the highest degree of recognition was awarded to the 'historic chiefs' of the War of Liberation, then to the Army, and then to the

builders and upholders of the state, that is, the bureaucracies which were the most exclusive, prestigious and privileged of all categories. The major players of the two main initiating factions (the 'industrialists' and 'educators') only figured after these privileged categories. They were trying to build up their eminence and form themselves into a 'corps' of professionals. Researchers actually belonged to none of these groupings. They only gained recognition by virtue of their activity contingent. When the state changed course, the lack of legitimate social allies would prove fatal.

### The Third Period—1983 to the Present: Dismemberment

Of the three decades in its short history, the last—the 1980s—can be said to have been the hardest and the most testing for the Algerian scientific community. As seen earlier, the first had in fact been one of foundation, exploration and laying the first steps. It had unfurled in the general mood of the time—the building of a modern society freed from colonialism, open to progress and community spirit. The satisfaction enjoyed by the cells of scientists who had been working at that time was twofold. First, despite being 'assisted' by foreign cooperators they were nonetheless gaining status levels from which they had previously been practically barred and were becoming 'seniors' in their fields of research. Second, they were aware of the part their work played in the common *oeuvre* and felt they were in some way 'activists' for the general cause. The task they were accomplishing had all the qualities of a 'mission'.

The second period can be said to have started when ONRS was set up in 1974, continuing up to its dissolution in 1983. In it, the scientific community was institutionalized and began working within organized frameworks of solid goals, precise deadlines and cost assessments. Unlike the first period, where researchers were somewhat left to their own devices, 'organization' had now become the overriding operative word behind the action. Since all the impetus came from the state-controlled institutions, the researchers' 'missionary' robes were progressively exchanged for those of 'civil servant', and militant commitment gave way to routine.

Yet, hardly had the community settled down, with the first networks established and the first results coming in for evaluation, everything in terms of both approach and style had to be changed from top to bottom. One or two points of history may be made here for a clearer understanding of the new situation. Indeed, Algeria's entire political arena underwent full-scale changes after the death of President Boumedienne. From the beginning of 1980, his successor, Chadli Benjedid, arranged an extraordinary congress for the ruling FLN—the only party in existence. It adopted another, quite different political stance. The new politics were more attuned to the 'spirit of the times'—Thatcherism, 'death of ideology' and free enterprise were the rage—and tabled extensive reforms to bring about a

total shake-up of the country's economic, social and political scene. Some of the major changes that were brought in during this period are as follows:

- The rapid and massive-scale industrialization programme was put on ice and attention diverted to the sectors of agriculture, housing, roads and other technical infrastructure.
- The public sector (80 per cent of the national economy) underwent in-depth restructuring. The big companies often covering whole branches of industrial activity (SONATRACH—petrol and gas; SNS—iron and steel, metallurgy; SONACOME—mechanical engineering), were split up into smaller units specific to technological sub-sectors or regions. So there were now over a hundred medium-sized companies and around two hundred units of more modest dimensions.
- The state progressively withdrew from most sectors, preferring partnerships with new 'social players', particularly private initiatives and foreign investments.
- Progress towards a free economy shifted up a gear when petrol prices plummeted in 1986, as petrol accounted for 90 per cent of Algeria's foreign currency earnings.

It was in these circumstances, amid the withdrawal of state-owned institutions, that ONRS was dissolved in 1983. The state retained direct control, but over a 'handful' of centres including the Centre des Energies Nouvelles (CEN—Centre for New Energies) which was chiefly nuclear. The scientific community then found itself in utter disarray, not without cause. Extreme institutional instability took hold in the breach left by the disappearance of ONRS. The following year, in 1984, the Commissariat à la Recherche Scientifique et Technique (CRST—Science and Technology Research Board) under the authority of the head of the government was set up. A few months later it was replaced by the Haut Commissariat à la Recherche (HCR—High Commission for Research), this time answerable to the Presidency of the Republic. The HCR in turn made way for a delegated ministry which was to be headed by a junior minister.

With the loss of the 'mother ship' of national research, scientists would thus also lose the main, if not sole, source of funding for their work. In the ten-year period 1979-1989, the annual per capita researcher grant dropped from DA122,000 to DA35,000 (the dinar meanwhile having been devalued), while the number of researchers dramatically increased from 800 to 3,000. That was not all. With the disappearance of its 'institutional research space', the young scientific community also lost its socio-professional status, which had been of great use in such an extremely socialist state society in the habit of working in corporations or on 'orders'. Researchers were now isolated in their various 'home establishments', such as universities, hospitals and research centres. There were still very few full-time

researchers, gradually losing their collective identity and hence their power to lobby politicians and influence decision making. They found themselves suddenly stranded in a hostile wilderness.

The other backers with whom they had begun establishing closed contacts, were in turn crippled by the corrosive effects of the state reforms. The big industrial companies being dismantled, the first elements of scientific and technical research that they had been putting together were consequently left high and dry. Funding allocated to research dwindled here, sometimes even drying up altogether (Table 2.5). Meanwhile, the restructuring of production cast a cloud of confusion over all the paths and networks that had begun being woven amongst the companies, and between them and the research institutions. Only the largest industrial establishments (SONATRACH in petrol research; SIDER in iron and steel; SONAREM in mining) continued to maintain their research units. Everywhere else, budgetary cut-backs along with restructuring plans ruthlessly wiped out the funds allocated to research. Scientists could not obtain any considerable support from the new private establishments, as they were still far too weak to finance such activities. The new policy reforms thus delivered a severe blow to university and industrial research.

**TABLE 2.5**  
**Research Budgets in the University Sector, 1976-90**

| <i>Years</i>               | <i>1976-82</i> | <i>1983-89</i> | <i>1990-94</i> |
|----------------------------|----------------|----------------|----------------|
| Capital Investments*       | 90000          | 50000          | 80000          |
| Recurring Expenditures*    | 100000         |                |                |
| No. of Researchers         | 900            | 2600           | 3600           |
| Mean Budget by Researcher* | 100            | 35             | 35             |

\* In thousand DA; IDA = IFF in 1979. IDA = 0.15F or approx. US \$0,025 in 1989.

The university scientific community was the worst hit. While it had been organizing and conducting its research work according to the S&T 'options' solemnly adopted by all the various successive post-independence political regimes, the education system had been on another path.<sup>13</sup> It had been trying to salvage a cultural heritage profoundly denaturalized at the hands of the colonialists: above all the Arabic language and those (chiefly religious) identity values representing the main elements of the 'fundamental nature of Algeria'. The two logics—of culture and identity for the education system, and of development and S&T for the 'techno-structure' to which the researcher community belonged—had been simultaneously working in two separate, parallel spheres; the former in the schools and the latter in business and the universities. Yet at that time, the first school-leavers were just entering university and on the basis of their cultural values they were attempting to challenge the leadership of their elders.

Thirty years on from independence, therefore, the battle of the 'M' (Muslim)—of the glory days of the UGEMA—is once again flaring up with just as much vigour, as if the identity question is simply coming out of suspended animation. This time, though, the 'M' is no longer being brandished by the elders, but by a youth filled with reproach for their predecessor's postivism and scornful of the values that come of it. Having been shamefully 'dumped' by a retreating state and being, for the moment, useless to a steadily diluting industrial system, university scientists are being challenged within the very walls of their own 'stronghold' by their own students. This has been enough to speed up a general process of withdrawal in a wide variety of forms:

**DEPARTURES ABROAD:** The classic 'brain drain' syndrome common to a majority of the Third World countries, which have heavily invested in higher technical education-training but which have not managed to set up a productive system making jobs available to new graduates, has engulfed Algeria now. In Algeria's case, second generation graduates are the ones leaving rather than their seniors. Although many are doing so, we do not as yet know the exact extent of the exodus. Most are from the technological and engineering sciences and head especially towards the USA, Canada, France and Germany. Departure is often final, since those leaving are still young enough to begin a new life 'over there'.<sup>14</sup> The hardest hit institutions are the major universities of science—Bab-Ezzour in Algiers, Es Senia in Oran, the University of Annaba, and the Boumerdes and Arzew centres of technology.

**RETREAT INTO TEACHING WORK:** This mainly affects the new provincial universities, whose difficult environment and incompetent bureaucracy discourage any effort to establish a team or network, or organize symposia. On a national level, social sciences and the arts are the hardest hit.<sup>15</sup>

**SUBSIDING VOCATIONS:** Probably this is the most important and disturbing phenomenon. In every discipline and academic establishment there are dwindling numbers of young researchers. Working conditions are deteriorating and the development of results has been reduced virtually to zero, while career

of an unpredictably complex political, economic and cultural environment. Although the third period of Algeria's brief history has been more arduous than expected, it is now in a new phase of apprenticeship and fresh procedures are already emerging. They may be less sure-footed than those of the 'golden age', but they are better aware of the complexity of things and more cautious of the fragility of 'all things institutional'. Scientific researcher associations are growing in number, now independent of little or untrusted state initiatives. They regroup research professionals (sometimes), university teachers (often) and associate particularly public sector company chiefs in their actions. In the majority of cases, their goal is to meet, exchange opinions and measure their strengths. The approaches are new, less bureaucratic, more directly linked to concrete areas of research and concentrated on the conditions for its revival. In these tempestuous times, which have shaken every certainty and profoundly damaged the national community of S&T, a new 'style' may be taking shape. And who knows, if it manages to flower, its bloom could mark the end of this gloomy period.<sup>16</sup>

### The Current Situation<sup>17</sup>

Having, in the space of thirty years, known the void of indifference, an intense, brief gain of autonomy under the aegis of the state, its loss and the ensuing endeavours to achieve fresh legitimacy, where does Algerian science stand today? We shall look at four of the problems it faces: institutional strategies, the reproduction of its communities, its sustaining 'niches' and its cognitive styles of science.

**INSTITUTIONAL STRATEGIES:** Algerian research was built parallel to the state, received its support and then had it more or less severed. The ordeal tested the mettle of various 'state sciences' and vocations, revealing whether they had staying power or not. Some genuine researchers would turn expatriate in the process. As for the institutions, they adopted variable strategies as a means to survive. Several types of situation can be seen.

The most able laboratories, often the first forged and now resistant kernels, have remained *at the university*. This is due to the doggedness of their members (including their founders) and the determination of a handful of people at the Ministry for Higher Education. They have struggled upstream to maintain the institutional frameworks for healthy scientific life (commissions of specialists, quality requirements and budgetary aid—though at a minimum, yet adapted and distributed directly to the producers). Today, these laboratories are endeavouring to tie contractual bonds with big companies, and they are striving to get their managers interested in postgraduate training and discipline-specific associations focusing on

matters of industrial innovation in chemistry, computer sciences, mechanical engineering, etc. Medicine is not as much linked with a 'parent' industry.<sup>18</sup> In the engineering schools (and institutes of technology), research is making an unprecedented comeback as these schools adopt a professional strategy for teaching PhDs.<sup>19</sup>

The research centres are, for the most part, much less productive. Looking for protection, they had put themselves entirely in the hands of the technical ministries after ONRS was dissolved. Significantly, they showed their alliance by ousting the university academicians who were running or wanted to work in these institutions, e.g., the Centre de Recherche en Océanographie (now the Institut Supérieur Maritime—ISMA) or the Centre de Recherches Nucléaires (Nuclear Research Centre) under the aegis of CEN. Meanwhile, the Ministry of Agriculture has barred university and agronomy school teachers from its research system, which is now split up into a whole host of product-specialized service stations. Allegiance has, however, earned these centres premises, equipment and a few posts for young researchers. But no original scientific programmes seem to have come of the fresh start. Their part of the bargain is that, when asked, they take on incidental and changeable 'applied' problems which can often be mundane and as such eventually dry up their imagination. The fact remains that these are among the best equipped places and that in several important disciplines (oceanography, agriculture, nuclear physics, etc.) there has been a de facto divorce between the research tools and those that know best how to use them. Some centres have obviously been affected by this, though less so, depending on the degree of change they have accepted in the hierarchy of their missions. One such example could be the Institut Pasteur, formerly known for its basic research before its epidemiology watch (a role nonetheless played with imagination) and vaccine production. The order of priorities has changed, and the Institute journal is having trouble appearing and is apparently being held in lower esteem.

The industrial company research units have been forcibly pushed to innovate. Since the dismembering of the consortia upon which they depended,

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occurring rather within the framework of scientific and discipline-specific associations or associations producing studies under contract! The latter form is promising, especially in the social sciences and in certain technological areas. The fact remains that it is hard to see how medicine or physics can work in such a fashion.

On top of all this, researchers and entire disciplines have vanished without a trace, as they were too tightly controlled by a 'state science' cultivating expressly dictated subjects or paradigms. Although the Algerian scientific community may appear to have entered an age of associations and specialist circles, replacing the institutions whose imagination has run dry seems nearly impossible. The small community that exists now still faces a dual problem: it needs a project to revive it and is having trouble simply reproducing.

**THE REPRODUCTION OF SCIENTIFIC COMMUNITIES:** Now that it is time to hand over the helm, the charismatic founders are paradoxically finding it more difficult than ever to pass on their leadership. The process is handicapped by the departure of the early followers and by the discord between the older and younger generations over the language used at work. The project to establish a new system of higher education (and then national research) had managed to bring in a good deal of expatriate talent back into the country in the 1970s. But the new course has forced many noteworthy second generation scientists out into the diaspora: those who had been called on to succeed the older masters and had long been preparing for it in major laboratories, and those already starting to work their way into provincial universities. The phenomenon has been accentuated by a change in the balance of power between the country's 'liberating' paradigms and the clear rise of political fundamentalism. It prevails not only at the universities but also in the top levels of the medical profession and in big industry (where it first began). An ever growing list of professionals are leaving the country

grounding (teaching methods and conceptual approaches), communication is rendered even more difficult because, until very recently, the Arab and French tongues had been completely opposed—like the symbols of two conflicting *Weltanschauung*. This politicizing of the 'language' question (content apart) polarizes attitudes and complicates integration in work teams. With scientists migrating and the generations having trouble in communicating, some of the most sure-footed laboratories are afraid for their survival. Since this is not a time for new creations, Algerian research is today reminiscent of the rock of Sisyphus: *hauled halfway up the slope and threatening to roll back down again*.

**NICHES OF SCIENCE:** One of the strong points today is medical science. It stands for more than one-third of the production registered by the international bibliographical databases (Table 2.6). Exceptions apart, this is work carried out within the framework of laboratories linked to a university chair and healthcare service. Such research is thus *niche*d in the medical profession and this feature seems to ensure its resistance. 'There isn't any interest recognized in research without healthcare here', says a professor of endocrinology, originally trained in the most basic research. 'That's why I requested a healthcare service at the same time as my laboratory'.<sup>20</sup>

**TABLE 2.6**  
Relative Publication Outputs by Main Research Areas  
(Percentages)

| Research Areas            | ONRS (1975-83) | PASCAL (1981-86) | ISI (1981-86) |
|---------------------------|----------------|------------------|---------------|
| Clinical Science          | -              | 28               | 23            |
| Bio-medical Science       | -              | 9                | 12            |
| Total Medical Science     | 69             | 37               | 35            |
| Other Biological Sciences | -              | 17               | 7             |
| Chemistry                 | -              | 13               | 22            |
| Math-Physics              | -              | 16               | 22            |
| Engineering Science       | -              | 7                | 11            |
| Earth-Ocean-Atmosphere    | -              | 10               | 3             |
| Non-medical Science       | 31             | 63               | 65            |

The teachers at the top of the hierarchy are often recognized researchers.<sup>21</sup> Furthermore, the medical profession takes pride in its work. It takes an interest in difficult diagnoses, it has a taste for self-perfection, and pictures itself pushing back the frontiers of its powers through technical modernization and the development of knowledge. That is undoubtedly why they are seen as the figureheads of top-level multi-talented professionals, who are at the same time healers, educationalists and researchers—thus considered to be 'complete men'.

The medical researchers' activities are also respected because they occupy the highest status levels the profession recognizes in its ranks—professors who are heads of departments at the university hospital. It is from such positions that, championing the cause of research, they more rigorously demand the presentation of original work to accompany applications for promotion. The activity thus benefits from the authority exerted by the status levels to which it gives access. Research maintains a rather discrete presence in standard medical practices. Yet, it is nonetheless well established, provided it conforms to the values of the profession (pre-eminence of healthcare and hospital prestige). It even constitutes a strategy of self-enhancement (albeit secondary to the satisfaction in the practice of healthcare). Research can shelter in the profession and therein cultivate its autonomy drive (including vis-à-vis a 'state science').

Few other subjects offer such shelter, although there are few professions (in terms of a social body, independent of the state and the sphere of 'family' solidarities). Engineers have neither acquired that kind of cohesion nor forged their ideal from a vision of an innovating mission. Industry (as a result may be) is not one of research's privileged niches.<sup>22</sup> Yet, things may develop with the need to adapt to changing markets and to settle for internal know-how because outside expertise can no longer be bought. Also, and this is important, with the efforts of the new engineering associations, engineers are making efforts to revive the public image of industrialism. Now they are vaunting the idea that innovation is a fundamentally important feature of their profession.

Higher education could constitute another niche for research. We have already noticed that the universities shelter some of the best and most resistant laboratories. But it is there that the legitimacy of this activity is most contested. Many students consider that the essential role of the masters they have been assigned is to basically pass on established knowledge. A majority of teachers<sup>23</sup> are challenging the demands for original work made on those looking for promotion. They consider that other qualities, other signs of devotion, ought to be taken into account. And administrative pressure has long since been moving in the same direction, increasing the standing mainly of educational and managerial tasks. Furthermore, a number of procedures do systematically hinder research. The public administration establishment refuses to receive money from any source other than the state, and submits expenditure to a priori financial control, and this impedes contracts with the production sector.<sup>24</sup> In all, the university just provides a place for a 'partial scientific community'—where activity remains subordinate to the 'vanities' of social life and professional ambition. However, it may be fairer to say that it is divided—one part of the teaching body upholding the 'vocation' (a minority, except in mathematics, chemistry and some areas of physics) and the other refusing it.

Paradoxically, research projects are now most favourably welcomed in the engineering schools (attended by some of the best students).

The best 'niche' could be said to lie in the researcher profession itself. Full-time researcher status does exist, no matter how minimally widespread it may be. The work takes place in research centres, chiefly those that have chosen to ally themselves with the technical ministries. Yet we have seen what a sterilizing strategy this can be. The researchers there work free of standard professional norms, publication demands, comparison with peers, etc., but have not really replaced them with any new, autonomous ones. In a few other centres under the university, the quirks of status demand that the few full-time researchers are paid from the institution's own coffers. Because of this, all members (including university academicians receiving pay from other sources) are compelled to go out and hunt for contracts. This is exhausting, sometimes monotonous and, at the end of the day, sterilizing. It can wear out the will-power of the best of them. The cases of both university and full-time researchers show that purely statutory institutionalization will provide scientific communities with neither guarantees nor the best shelter. A distinction must, therefore, be drawn between institutionalization and professionalization. The former occurs with the sometimes tardy interest the state takes in science. The latter involves the transition to routine, following the gaining of an autonomous social role and social legitimacy, and the assimilation of its norms and ideals.

**STYLES OF SCIENCE:** The 1972 national debate has been just about the only one on Algeria's S&T options to touch the imagination of the public. Although the options have changed, it does not seem as if another is likely to take place for the time being. The interest of the state has gone and that of civilian society lies dormant. Yet, for all that, scientific activity has not come to a standstill, and moves are afoot to restructure the scientific field.

The middle period (that of ONRS) is the one to have stamped its mark on today's most established styles. Its code of ethics was one of a 'national development-oriented science'. It brought in a form of 'asceticism' which involved playing an active role in the world rather than rejecting it.<sup>25</sup> An important driving force was the feeling of what one owes to oneself and to the country. It goes hand-in-hand with a defiance of undue pressure from other spheres or other social bodies such as political powers, privilege-seeking families or neighbourhood groups. Here we can see scientific activity striving for relative autonomy. This trend is working more to enhance the value of 'travel' (which characterized early life for many of the founders) and its principles of openness, rather than questions of roots and loyalty towards traditional groups of affiliation. It is bracing itself in case it is forced out on to the fringes in order to maintain a now firmly established 'vocation'. At the same time, study subjects are chosen with foreseeable local needs in mind. This is not to say the choices are steered by governmental instructions but, on the contrary, many scientists complain about

having lacked such guidance. They are the ones who have been scrutinizing their environment and transposing their knowledge so as to adapt it to what they judge to be the work of public interest.

As such, chemistry is turning to laboratory research on catalysis, which eventually ought to be of interest to the petrol companies. Mathematicians are developing their already great abilities in partial derivative equations with a view to possible applications in computer science (an industry yet to be established) or hydraulics (pipeline whirlpools and liquid flow). Sociologists are showing a preference for rural or occupational sociology. Nationalistic tones, however, are making way for a variety of discipline-specific interpretations that can even vary within each. This is due to the flexibility of the ONRS strategy, which left the subject selection to the people involved. Medical research, for example, is vaunting three styles of science: the first is propaedeutic-clinical research, of which surgery aimed at teaching is one area of preference; second is epidemiology—an action-oriented research linked to testing innovating methods of treatment and prevention in known and widely prevailing diseases such as tuberculosis and child mortality; and third is exploration—a sophisticated strategy in the choosing of rare afflictions which occur more frequently in this country than elsewhere and which are likely to affect forthcoming death rates. National styles of science are thus being forged with their preferred subjects, charismatic figures and 'flagship' laboratories. The norms and ideals accommodate variants and specifications from one discipline to the other.<sup>27</sup>

Algerian science first emerged with the backing of the state. This gave rise to ambiguities which appeared most clearly in the third period, with the breakdowns caused by the shedding of that state support. A subtle hierarchy of disciplines had taken shape. It was not unreleased

being reduced to simple, service laboratories. In a number of disciplines, the younger generation found itself having trouble deciding which research subjects to follow. Some leapt at the problems offered by the mainstream of world science. Others plunged into empirical studies on fashionable headline subjects of the day. There was a growth of 'individual' work projects. Some were ingeniously plagiaristic. Others amounted to little more than a rehash of existing knowledge and thus served only to saturate. Such teething problems were due to the fact that the research system, which recurrently confronted changes, did not have time long enough to infuse professional norms and the drive for scientific autonomy was taking a back seat to personal career strategies.<sup>29</sup>

The winds of cognitive renovation have not yet blown in. If fresh styles are emerging, it is paradoxically due to the new developments in world science and the ripples they produce here through on-going cooperation, post-doctoral training and expatriate researchers keeping contact with their colleagues back home. In particular, advances in techno-sciences or recourse to sophisticated methods radiate the most appeal. For sure, this is a time when all sorts of styles of science are joining forces in a pan-disciplinary attempt to safeguard a minimum of research activity. We can nevertheless detect an underlying wrestling in several fields and sometimes a wild struggle of newly opposing styles. In biology, for example, a school of thought vaunting painstaking fieldwork, multi-disciplinarity, application, experimentation in stations or rural environments, whose area of 'excellence' is the environmental sciences constituted at the botanical laboratory and the Centre d'Etudes des Zones Arides (Arid Zones Research Centre), is finding itself opposed by a movement promoting molecular biology. The latter field, with its laboratory work, top-level research at the heart of the discipline and a trend to publish in prestigious international journals rather than 'local' journals, seems to have an upper hand. In terms of practical action, it devises more initiatives in genetic engineering than biological control." Other disciplines could have served to illustrate our point, but the conflict between these two is particularly fierce and typical. It brings the inventive styles of a local, 'national' science, still very much imbued with the constructive nationalist upsurge, face-to-face with the ambitions stemming more directly from the mainstream with its powers of attraction and renovating approaches—for world science did not take to the sidelines when Algerian science was 'suspended' and Sisyphus began serving his sentence.

## Annexure

### The Algerian Research System

This system includes today:

1. Centres and teams which most often have been created or re-established by ONRS during its short life. Among them are:
  - The 'historical' centres inherited at independence such as the Observatoire Astronomique (1880), the Institut de Météorologie et de Physique du Globe (1883), the Institut Pasteur d'Alger (1894), the Institut d'Océanographie (1930), the Institut de Prospection Minière (1942) and the Anti-cancer Centre (1950). Other centres have disappeared or drastically changed their orientations. This is the case for the old institutes such as the Institut de Recherches Sahariennes (1937), the Institut d'Hygiène et de Médecine Coloniale (1923), the Institut de Géographie et d'Urbanisme (1937-42), the Institut d'Archéologie et d'Ethnologie, and the Centre de Recherche en Anthropologie, Pré-histoire et Archéologie (CRAPE).
  - Some fifteen new centres created by ONRS, in particular in the following research areas of agronomy, biological resources, arid zones, geo-sciences, animal and human biology, astronomy, astrophysics, renewable energy, scientific and technical information, regional development, applied economy, land planning, architecture and urbanism, history and linguistics. Research in computer science and mathematics, chemistry and physics as well as clinical medical research are most likely to be carried out within university laboratories. ONRS has created more than eighty such laboratories.
2. The 'strategic' centres such as nuclear studies established under a separate entity. (A centre on nuclear studies was created as early as 1950.)
3. Research centres under technical ministries. Today, they are mainly concerned with technical service functions (agricultural tests, quality control). A few of them are conducting development research projects (building and public constructions, hydraulics, public health, statistics, demography-sociology).
4. Laboratories established by the big state enterprises chiefly for electricity, gas, mining, construction materials, and of course hydrocarbons, and the iron and steel industries (SIDER)—each of them with its own research centre.

### The Human Resources

The evaluation of the number of active researchers is problematic. In 1991, the Ministry for Higher Education estimated that about one-fourth of the teaching staff was involved in research activities on a part-time basis (one-fourth to one-third of their time). Thus, Algerian universities are the home to some 700 full-time equivalent researchers for a total teaching staff numbering approximately 10,000.

In 1985, there were approximately 300 researchers in the 'productive' sector and slightly more than 100 in the 'strategic' sector. Altogether the Algerian research potential would thus correspond to some 1,000 full-time equivalent researchers. Yet, some 7,000 to 8,000 people are participating in R&D activities on a part-time

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basis if one were also to include PhD candidates, some engineers and some medical doctors.

### Notes

1. Still having, at this stage, trouble being accepted by the Academy and the profession.
2. Research sponsored by the Institute Pasteur in North Africa resulted in two Nobel Prizes in medicine: one to Laveran in 1907 for his work on malaria; and the other to Nicolle in 1928 for his work on typhus.
3. An Académie des Sciences Coloniales was created after the First World War. Two other important colony-oriented metropolitan institutions for the training of colonial scientific personnel were the École Supérieure d'Agriculture Tropicale and the Institut de Médecine Vétérinaire Exotique. By 1930, some twenty agricultural stations and a high school of agriculture were established in Algeria. (Bonneuil and Kleiche, 1993).
4. In 1960, there were almost 2,000 Algerian students. Of these, 1,200 were enrolled in France and 800 in Algeria, that is, 12 per cent of the colony's total student population of 6,500. Let it be known that at that time, 90 per cent of Algeria's total population was Algerian. Further details can be found in the excellent work of Pervillé (1984).
5. French colonial law made a clear distinction between Algerians, known as 'French-Moslems' and European settlers known as 'French'. This means of identification disappeared in 1958, but then the Algerian students claimed it back to draw a political line between themselves and other associations, the Association Générale des Etudiants Algériens (AGEA—Algerian Students Association) for example. The defiant stance of the 'M' (for Muslim) was a decisive factor in the 1955 founding of the Union Générale des Etudiants Musulmans Algériens (UGEMA—General Union of Algerian Muslim Students). It disappeared altogether in 1962, with independence and the creation of the Union Nationale des Etudiants Algériens (UNEA), only to re-emerge some thirty years later when the first Islamic student associations were formed.
6. The 'inner circle' was composed of the first Algerian students to sign up with the nationalist independence movement at a relatively early stage: Mohammed Seddik Benyahia, later to become Minister for Further Education and Scientific Research; Belaid Abdessalam, the future Minister for Industry and Energy, considered to be the 'father' of Algerian industrialization; M. Baghli, who during the 1970s, was to take charge of setting up the Boumerdes technology complex; etc. The real collective brain of what was so e e the'(Algeria) Tj0 Tc(n) Tj2.975

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en Architecture-Urbanisme, the Centre d'Etudes et Recherches en Aménagement du territoire, and the Centre de Recherche en Economie Appliquée were creating their respective cahiers, whereas the Institut National de Santé Publique published a bulletin. Most of these journals, however, have disappeared since 1985 with the exception of the *Cahiers du CREAD*, *Cahiers du CENEAP*, and the *Bulletin de l'INSP*.

12. In these countries, the production sector is instructed by the state to invest in long-term research programmes in collaboration with universities: a useful tool for carrying research results through to development and marketing.
13. For a detailed analysis on this see El Kenz (1995).
14. The Centre de Recherche en Economie Appliquée pour le Développement (CREAD), Algiers is currently conducting a survey on this matter.
15. Out of the 370 research projects, corresponding to the nationwide activity of 2,100 university researchers, submitted in 1990, 25 per cent were in the social sciences and the arts. Biology was on top with fifty-seven projects (456 researchers), followed by electronics (forty-three projects, 154 researchers), physics (forty-two projects, 214 researchers), mathematics/computer science (thirty-one projects, 125 researchers), and metallurgy and mechanical engineering (thirty-three projects, 107 researchers). The number of teachers participating in research activities was highest at the University of Bab-Ezzouar (496 of the 723 teachers being researchers, that is, 68 per cent). Then came the University of Oran (293 researchers out of 519 teachers) and the Alger Centre (233 researchers out of 698 teachers). For all other universities, this ratio falls to around 20 per cent, at times even around 10 per cent. We must n

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27. In health, for example, loyalty prevails to public service and a desire to associate research, teaching and healthcare.
28. For example, in the social sciences, anthropology was branded as being colonial, and political science and sociology concerned with conducting small-scale qualitative surveys instead of quantitative surveys on conventional themes were disliked. The former structures have left their imprint, for even after the state withdrew it continued to have a lasting effect on the spirit of certain fields and many researchers.
29. In medical science, to the rage of the imaginative founding fathers, an increasing number of so-called epidemiological studies do little more than relay the state of the health of the population, lacking the gift of both foresight and prescription (e.g., to suggest new methods of diagnosis and prevention). In the social sciences, far too much work continues to turn on analyses of reported speech rather than field surveys, and remains far too easily cocooned in the safety of the established 'high church', that is, occupational sociology, rural sociology, the social status of women, religious values, etc.
30. Insect or pest control techniques which are a part of the environmental sciences referred earlier.

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